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Observations and Measurements

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i. Preface

This Best Practices Document was produced as part of the OGC's Sensor Web Enablement (SWE) activity. This latest version was produced under the OGC Web Services (OWS) 4 Initiative, conducted June - December 2006.

Suggested additions, changes, and comments on this report are welcome and encouraged. Such suggestions may be submitted by OGC portal message, email message, or by making suggested changes in an edited copy of this document.

The changes made in this document version, relative to the previous version, are tracked by Microsoft Word, and can be viewed if desired. If you choose to submit suggested changes by editing this document, please first accept all the current changes, and then make your suggested changes with change tracking on.

ii. Submitting organizations

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

Commonwealth Scientific and Industrial Research Organisation (Australia) (CSIRO).

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iv. Revision history

Date	Release	Editor	Primary clauses modified	Description
2003-02-11	0.9.2	Simon Cox	Baseline version	OGC Recommendation Paper arising from OWS-1.2
2005-10-07	0.10	Simon Cox	All	New version of model emerging from OWS3 Model converted to ISO conformant UML Document simplified, much discursive discussion material removed Systematic gradation of instance examples NOTE: Reference and bibliography still need cleaning up
2005-10-07	0.11	Simon Cox	v., vi., 1, 3, 6 (minor), 6.6.2, 7 (minor), 7.3.3.5, 8	
2006-01-30	0.12	Simon Cox, Alex Robin	7, Annexes	Added generic “xml encoding” for arrays and tables, added CommonObservation examples; replaced metaLite with ISO19139 GMD schema
2006-02-24	0.13	Simon	6, 7, 8, Annexes	Minor wording clarifications; inserted

		Cox		discussion of time-series/feature-of-interest, etc; inserted better introduction to three result encoding variants; added discussion of observation vs interpretation; move detailed RecordSchema model to Annex.
2006-08-23	0.14	Simon Cox		Major revision Add discussion of constant vs coverage properties/results Add normative clause on SamplingFeatures Clarify Feature/Coverage/Obs relationships Move XML examples clause to Annex, remove compact encoding variants Add Annex providing terminology mapping Numerous editorial changes Stubs for conformance rules

v. Changes to the OpenGIS® Specification

The OpenGIS® Specification requires changes to accommodate the technical contents of this document. The following is a list of the required changes:

a) Observations and Measurements to be added to the OGC Abstract Specification as a new topic.

b) CV_DiscreteTimeInstantCoverage and CV_TimeInstantValuePair to be added to CV package in the harmonized model.

c) CV_DiscreteElementCoverage and CV_ElementValuePair to be added to CV package in the harmonized model.

vi. Future work

Improvements in this document are desirable to

1. Correct numbering of Annex sections

2. Clarify relationship between (O&M) Record/CV_DiscreteCoverage/RecordType, (SensorML) DataValue/DataDefinition

3. The Event model introduced as parent to Observation may be of more general applicability, so may merit a separate specification in due course

4. The Phenomenon model may be removed to separate documentation in the SWE architecture spec

Foreword

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. Open Geospatial Consortium Inc. shall not be held responsible for identifying any or all such patent rights. However, to date, no such rights have been claimed or identified.

This report replaces the OGC Recommendation Paper 05-087r3 *Observations and Measurements*. The following changes have been made to the model presented earlier:

1. A generic “eventParameter” attribute replaces typed parameters on the Event and Observation classes

2. A <<Union>> class is used as the target of the Observation/procedure association

3. The “location” attribute of the Observation class has been removed

4. The “Array” and “Grid” classes used for some Observation/result values have been replaced with specializations of CV_Coverage from ISO 19123

5. The UML model defines a generic Observation class, which has a result whose content model is “Any”. In the XML Schema implementation an additional class AbstractObservation is introduced, to act as the abstract parent class for all specialized observation types including the generic Observation. This strategy allows us to avoid having to implement the attribute-type override using XML Schema “restriction” which is notoriously difficult, especially in a mixed-namespace context.

A set of XML schemas implementing the model as a GML Application Schema is provided in ANNEX D.

This specification was developed under the OWS 4 initiative as part of the Sensor Web Enablement thread. It provides the primary information model for requests to and responses from the Sensor Observation Service interface (OGC 05-088). It is compatible with a number of additional resources: descriptions of measurement procedures or sensors, which may use Sensor Model Language (OGC 05-086); a source for definitions of reference systems, such as units of measure and codelists, definitions of phenomena and related information.

Introduction

OGC's Sensor Web Enablement (SWE) activity, which is being executed through the OGC Web Services (OWS) initiatives (under the Interoperability Program), is establishing the interfaces and protocols that will enable a "Sensor Web" through which applications and services will be able to access sensors of all types over the Web. These initiatives have defined, prototyped and tested several foundational components needed for a Sensor Web, namely:

1. **Sensor Model Language (SensorML)** – The general models and XML encodings for sensors. SensorML originated under OWS 1.1, was significantly enhanced under OWS 1.2 and OWS 3 and is now available as a version 0 specification in connection with an OGC RFC.

2. **Transducer Markup Language (TML)** – A model and XML encodings for primitive transducer data. TML originated external to OWS, but was significantly enhanced under OWS 3 and is now available as a version 0 specification in connection with an OGC RFC.

3. **Observations & Measurements (O&M)** - The general models and XML encodings for observations and measurements, including but not restricted to those using sensors. O&M originated under OWS 1.1 and was significantly enhanced under OWS 1.2, OWS 3 and OWS 4

4. **Sensor Observation Service (SOS)** – A service by which a client can obtain observations from one or more sensors/platforms (can be of mixed sensor/platform types). The SOS operations signature directly reflects the Observations and Measurements information model. Clients can also obtain information that describes the associated sensors and platforms. This service originated as Sensor Collection Service under OWS 1.1 and OWS 1.2, and was renamed and significantly enhanced in OWS 3, and is now available as a version 0 specification in connection with an OGC RFC.

5. **Sensor Planning Service (SPS)** – A service by which a client can determine collection feasibility for a desired set of collection requests for one or more mobile sensors/platforms, or a client may submit collection requests directly to these sensors/platforms. This service was defined under OWS 1.2, OWS 3 and significantly enhanced under OWS 4.

6. **Sensor Alert Service (SAS)** – A service providing active (push-based) access to sensor data.

7. **Web Notification Service (WNS)** – A service by which a client may conduct asynchronous dialogues (message interchanges) with one or more other services. This service is useful when many collaborating services are required

to satisfy a client request, and/or when significant delays are involved is satisfying the request.

This document specifies Observations and Measurements. The other components are specified under separate cover.

Herein we describe a framework and encoding for measurements and observations. This is required specifically for the Sensor Observation Service and related components of an OGC Sensor Web Enablement capability, and also for general support for OGC compliant systems dealing in technical measurements in science and engineering.

The aim is to define a number of terms used for measurements, and the relationships between them. This proposal discusses **observation, measurement, result, procedure, feature of interest, observed property, phenomenon, coverage** and related terms, presented using UML class diagrams and in equivalent GML conformant XML serialisations. The scope covers observations and measurements whose results may be quantities, categories, temporal and geometry values, coverages, and composites and arrays of any of these.

This report is a major revision of reports prepared during the OGC Web Services 1.1, 1.2 and 3 initiatives.

This work was supported by OGC through the OWS-4 Interoperability project, and by the Water Resources Observation Network activity based at CSIRO Australia.

OGC Abstract Specification — Observations and Measurements

1 Scope

We describe a conceptual model and encoding for observations and measurements. This is formalized as an Application Schema, but is applicable across a wide variety of application domains.

An Observation is an event with a result which has a value describing some phenomenon. The observation event is modelled as a Feature within the context of the General Feature Model [ISO 19101, ISO 19109]. An observation feature binds a result to a feature of interest, upon which the observation was made. The observed property is a property of the feature of interest. An observation uses a procedure to determine the value of the result, which may involve a sensor or observer, analytical procedure, simulation or other numerical process. The observation pattern and feature is primarily useful for capturing metadata associated with the estimation of feature properties, which is important particularly when error in this estimate is of interest.

An observation results in an estimate of the value of a property of the feature of interest. Observation values may have many datatypes, including primitive types like category or measure, but also more complex types such as time, location and geometry. Complex results are obtained when the observed property requires multiple components for its encoding. Furthermore, if the property varies on the feature of interest, then the result is a coverage, whose domain is the feature. In a physical realisation, the result will typically be sampled on the domain, and hence represented as a discrete coverage.

The value normally requires a scale or reference system to provide the context for its interpretation and valid operations on it. These include the scale or unit of measure for a quantity, a dictionary or “code space” for a category, a spatial reference system for location and geometry, and a temporal reference system for time values. A value may be constructed by aggregating primitive values, to build tuples, arrays and lists, and compound values such as vectors and tensors, in which case the structure of the result is described by a record schema. An observed value may be semantically typed according to the phenomenon being observed or observable, sometimes called the measurand or determinand. Observed values may have other properties, such as quality indicators.

We discuss how the observation and measurement model is used in the context of SensorWeb, noting that different parts of the information model may be provided by different services.

Additional components that are used, but not described, in this report include:

- Sensor Model Language (SensorML) & Sensor Instance/Sensor Type registries,
- Reference System definitions (CRS, frames, units of measure, dictionaries & category lists),
- Semantic definition of phenomena, and
- Geometry and temporal objects.

2 Conformance

2.1 Overview

Clauses 6 and 7 of this Specification use the Unified Modeling Language (UML) to present conceptual schemas for describing Observations and Sampling Features. These schemas define conceptual classes that (i) may be considered to comprise a cross-domain application schema, or (ii) may be used in application schemas, profiles and implementation specifications. The document concerns ONLY externally visible interfaces and places no restriction on the underlying implementations other than what is needed to satisfy the interface specifications in the actual situation.

ANNEX D of this Specification specifies XML Schema components, in the form of GML Application Schemas that implement the conceptual model in accordance with ISO 19136.

This clause defines a set of conformance classes that will support applications whose requirements range from the minimum necessary to define data structures to full object implementation.

This flexibility is controlled by a set of UML types that can be implemented in a variety of manners. Common names for “metaphorically identical” but technically different entities are acceptable. The UML model in this Specification defines conceptual classes, various software systems define implementation classes or data structures, and the XML following the encoding standard (ISO 19136) defines entity tags. All of these reference the same information content. There is no difficulty in allowing the use of the same name to represent the same information content even though at a deeper level there are significant technical differences in the digital entities being implemented. This allows types defined in the UML model to be used directly in application schemas.

2.2 Conformance classes related to Application Schemas including Observations and Measurements

The conformance rules for Application Schemas in general are described in ISO 19109. Application Schemas also claiming conformance to this Specification shall also conform to the rules specified in Clauses 6 and 7 and pass all relevant test cases of the Abstract Test Suite in ANNEX A. Depending on the characteristics of an Application Schema, NN

conformance classes are distinguished. Table 1 lists these classes and the corresponding Subclause of the AbstractTest Suite.

Table 1 — Conformance classes related to Application Schemas including Observations and Measurements

Conformance class	Subclause of the Abstract Test Suite

TBC

3 Normative references

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

ISO 1000:1994, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 8601:2004, *Data elements and interchange formats — Information interchange Representation of dates and times*

ISO/IEC 11404:1996, Information technology — Programming languages, their environments and system software interfaces – Language-independent datatypes

ISO 19101:2003, *Geographic Information--ReferenceModel*

ISO/TS 19103:2006, *Geographic Information — Conceptual schema language*

ISO 19107:2003, *Geographic Information — Spatial schema*

ISO 19108:2002, *Geographic Information — Temporal schema*

ISO 19109:2006, *Geographic Information — Rules for application schemas*

ISO 19110:2006 , Geographic Information – Feature cataloguing methodology

ISO 19115:2003, *Geographic Information — Metadata*

ISO 19118:—, *Geographic Information — Encoding*

ISO 19123:—, *Geographic Information — Coverages*

ISO DIS 19136:—[1], *Geographic Information — Geography Markup Language*

ISO/DTS 19139:—[2], *Geographic Information — Metadata — XML schema implementation*

IETF RFC 2396, *Uniform Resource Identifiers (URI): Generic Syntax. (August 1998)*

OpenGIS® Implementation Specification *Geography Markup Language, version 3.2. OGC Document 06-XXX* http://www.opengeospatial.org/

OpenGIS® Interoperability Program Report *Sensor Model Language, OGC document 05-086.*

OpenGIS® Interoperability Program Report *Sensor Observation Service, OGC document 05-088.*

OpenGIS® Interoperability Program Report *Transducer Markup Language, OGC document 05-085.*

UCUM, Unified Code for Units of Measure, Schadow, G. and McDonald, C. J. (eds.), <http://aurora.rg.iupui.edu/UCUM>

W3C XLink, *XML Linking Language (XLink) Version 1.0. W3C Recommendation (27 June 2001)*

W3C XML, *Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation (6 October 2000)*

W3C XML Namespaces, *Namespaces in XML. W3C Recommendation (14 January 1999)*

W3C XML Schema Part 1, *XML Schema Part 1: Structures. W3C Recommendation (2 May 2001)*

W3C XML Schema Part 2, *XML Schema Part 2: Datatypes. W3C Recommendation (2 May 2001)*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
analyte
species subject to **observation.** Subset of **determinand** or **observable**.

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[1] To be published

[2] To be published

4.2
application schema
conceptual schema for data required by one or more applications

[ISO 19101]

4.3
GML application schema
application schema written in XML Schema according to the rules specified in ISO 19136

[ISO 19136]

4.4
association
semantic relationship between two or more classifiers that specifies connections among their instances

[ISO 19501-1]

NOTE: A binary association is an association among exactly two classifiers (including the possibility of an association from a classifier to itself).

4.5
attribute <UML>
feature within a classifier that describes a range of values that instances of the classifier may hold

NOTE: An attribute is semantically equivalent to a composition association; however, the intent and usage is normally different.

4.6
attribute <XML>
name-value pair contained in an **element**

4.7
child element <XML>
immediate descendant **element** of an **element**

4.8
codespace
rule or authority for a code, name, term or category label

EXAMPLE Examples of codespaces include dictionaries, authorities, codelists, patterns, etc.

4.9
coordinate reference system
coordinate system that is related to the real world by a datum [ISO 19111]

4.10
coverage
feature that acts as a function to return values from its range for any direct position within its spatiotemporal domain

[ISO 19123]

4.11
data type
specification of a value domain with operations allowed on values in this domain

[ISO/TS 19103]

EXAMPLE Integer, Real, Boolean, String, Date (conversion of a data into a series of codes).

NOTE: Data types include primitive predefined types and user-definable types. All instances of a data types lack identity.

NOTE:

4.12
determinand
parameter or a characteristic of a phenomenon subject to **observation.** Synonym for **observable.**

4.13
domain
well-defined **set**

[ISO/TS 19103]

NOTE: 1 A mathematical function may be defined on this set, i.e. in a function f:A→B A is the domain of the function f.

NOTE: 2 A domain as in domain of discourse refers to a subject or area of interest.

4.14
element <XML>
basic information item of an XML document containing **child elements**, **attributes** and character data

NOTE: From the XML Information Set: “Each XML document contains one or more elements, the boundaries of which are either delimited by start-tags and end-tags, or, for empty elements, by an empty-element tag. Each element has a type, identified by name, sometimes called its ‘generic identifier’ (GI), and may have a set of attribute specifications. Each attribute specification has a name and a value.”

4.15
feature
abstraction of real world phenomena

[ISO 19101]

NOTE: A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

4.16
feature association
relationship that links instances of one feature type with instances of the same or different feature type

[ISO 19110]

4.17
GML application schema
application schema implemented according to ISO 19136

4.18
grid
network composed of two or more sets of **curves** in which the members of each set intersect the members of the other sets in an algorithmic way

[ISO 19123]

NOTE: The curves partition a space into grid cells.

4.19
measure (noun)
value described using a numeric amount with a scale or using a scalar reference system

[ISO/TS 19103]

NOTE: When used as a noun, measure is a synonym for physical quantity.

4.20
measurement (noun)
an observation whose result is a measure

4.21
measurand
physical parameter or a characteristic of a phenomenon subject to a **measurement,** whose value is described using a Measure (ISO 19103). Subset of **determinand** or **observable**.

4.22
namespace <XML>
collection of names, identified by a URI reference, which are used in XML documents as element names and attribute names [W3C XML Namespaces]

4.23
observable (noun)
parameter or a characteristic of a phenomenon subject to **observation.** Synonym for **determinand.**

4.24
observation (noun)
an act of observing a property or phenomenon, with the goal of producing an estimate of the value of the property. A specialized event whose result is a data value.

4.25
phenomenon
characteristic of one or more feature types, the value for which must be estimated by application of some procedure in an observation.

4.26
procedure
method, algorithm or instrument

4.27
property <General Feature Model>
characteristic of a feature type, including attribute, association role, defined behaviour, feature association, specialization and generalization relationship, constraints

[ISO 19109]

4.28
property <GML>
a **child element** of a GML object

NOTE: It corresponds to feature attribute and feature association role in ISO 19109. If a GML property of a feature has an xlink:href attribute that references a feature, the property represents a feature association role.

4.29
range
set of all values a function f can take as its arguments vary over its domain

4.30
result
an estimate of the value of some property generated by a known procedure

4.31
scale
a particular way of assigning numbers or symbols to measure something is called a scale of measurement [SAR1995].

4.32
schema
formal description of a model

[ISO 19101]

NOTE: In general, a schema is an abstract representation of an object's characteristics and relationship to other objects. An XML schema represents the relationship between the attributes and elements of an XML object (for example, a document or a portion of a document)

4.33
schema <XML Schema>
collection of schema components within the same target **namespace**

EXAMPLE Schema components of W3C XML Schema are types, elements, attributes, groups, etc.

4.34
schema document <XML Schema>
XML document containing schema component definitions and declarations

NOTE: The W3C XML Schema provides an XML interchange format for schema information. A single schema document provides descriptions of components associated with a single XML namespace, but several documents may describe components in the same schema, i.e. the same target namespace.

4.35
semantic type
category of objects that share some common characteristics and are thus given an identifying type name in a particular domain of discourse

4.36
sequence
finite, ordered collection of related items (objects or values) that may be repeated

[ISO 19107]

4.37
set
unordered collection of related items (**objects** or values) with no repetition

[ISO 19107]

4.38
tag <XML>
markup in an XML document delimiting the content of an **element**

EXAMPLE <Road>

NOTE: A tag with no forward slash (e.g. <Road>) is called a start-tag (also opening tag), and one with a forward slash (e.g. </Road> is called an end-tag (also closing tag).

4.39
tuple
ordered list of values

4.40
UML application schema
application schema written in UML according to ISO 19109

4.41
Uniform Resource Identifier (URI)
unique identifier for a resource, structured in conformance with IETF RFC 2396

NOTE: The general syntax is <scheme>::<scheme-specific-part>. The hierarchical syntax with a namespace is <scheme>://<authority><path>?<query> - see [RFC 2396].

4.42
value
member of the value-space of a datatype. A value may use one of a variety of scales including nominal, ordinal, ratio and interval, spatial and temporal. Primitive datatypes may be combined to form aggregate datatypes with aggregate values, including vectors, tensors and images [ISO11404].

5 Conventions

5.1 Symbols (and abbreviated terms)

GFM	General Feature Model
GML	Geography Markup Language
ISO	International Organization for Standardization
O&M	Observations and Measurements
OGC	Open Geospatial Consortium
OWS	OGC Web Services
SensorML	Sensor Model Language
SAS	Sensor Alert Service
SOS	Sensor Observation Service
SPS	Sensor Planning Service
SWE	Sensor Web Enablement
UML	Unified Modeling Language
WXS	W3C XML Schema Definition Language
XML	Extensible Markup Language
1D	One Dimensional
2D	Two Dimensional
3D	Three Dimensional

5.2 UML notation

Most diagrams that appear in this specification are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of the OGC Web Services Common Implementation Specification [OGC 04-016r2].

Many of the models refer to classes from various models in the ISO 19100 series of international standards. In this document these components have been imported from the ISO Harmonized Model as of 2004-05-11.

The UML is conformant with the profile described in ISO 19103 and ISO 19136 (GML) Annex E. Use of this restricted idiom supports direct transformation into a GML Application Schema.

The prose explanation of the model uses the term “property” to refer to both class attributes and association roles. This is consistent with the General Feature Model described in ISO 19109. In the context of properties, the term “value” refers to either a literal (for attributes whose type is simple), or to an instance of the class providing the type of the attribute or target of the association. Within the explanation, the property names are sometimes used as natural language words where this assists in constructing a readable text.

5.3 Document terms and definitions

This document uses the specification terms defined in Subclause 5.3 of [OGC 04-016r2].

6 A model for Observations and Measurements

6.1 Introduction

In this Clause, we describe a model for observations and associated components. The analysis is presented using UML static structure diagrams.

6.2 An observation is an event

We follow Fowler [FOW1998] and consider an observation to be an act through which a number, term or other symbol is assigned to a phenomenon. An observation is a kind of *event* and thus is associated with a discrete time. The phenomenon is associated with an identifiable object, which is the *feature of interest* of the observation. The observation uses a *procedure*, which is often an instrument or sensor [NRC1995] but may be a process chain, human observer, an algorithm, a computation or simulator. The key idea is that the observation *result* is an estimate of the value of some property of the feature of interest, and the other observation properties provide context or metadata to support evaluation, interpretation and use of the result.

In conventional measurement theory [e.g. KRALST, SAR1995, VIM] the term "measurement" is used for the concept. However, Fowler's distinction between measurement and category-observation has been adopted in more recent work [NIE2001, YOD] so the term "observation" is used here for the general concept. "Measurement" may be reserved for cases where the result is a numeric quantity.

The relationship between the properties of an observation and those of its feature of interest is key to the semantics of the model. This is discussed in detail in sub-clause 6.4 and sub-clause 8.1.

A coverage may appear as a consequence of observations, either as the result of a single observation or by compiling results from a suite of observations with a consistent observed property. This is discussed further in sub-clause 6.8 and sub-clause 8.6.

6.3 Basic observation model

The basic observation model is presented in Figure 1.

Event is a feature type [ISO 19101, ISO 19109, OGC AS Topic 0] characterized primarily by a **time** whose value is a temporal object (TM_Object—ISO 19108). The event time will often be an instant or period (TM_Instant or TM_Period), though it may be characterised using temporal topology. Explicit associations with preceding or following events may also be known.

Observation is a specialized event, with a mandatory **result**. The observed property may be any property associated with the type of the feature of interest, so the type of the result is shown as *Any*, and must be provided at the data instance level.

NOTE: In the XML implementation, an element may be declared in the schema to have type="anyType", and the type may be indicated within a data instance (a) using the xsi:type attribute on the result element, or (b) through declarations for components appearing explicitly within the element content.

An observation may include an indication of its event-specific **quality**.

Persons or organisations (CI_ResponsibleParty—ISO 19115) may be identified as **responsible** for the observation.

Other properties characterizing all observations are shown as associations, with the following roleNames:

– the value of the **featureOfInterest** is a Feature (ISO 19109, ISO 19101) which is a representation of the real-world object regarding which the observation is made

– the value of the **observedProperty** identifies or describes the phenomenon for which the observation result provides an estimate of its value. The type of the observation result must be consistent with the observed property, and the scale or scope for the value must be consistent with the quantity or category type.

NOTE: A model and ontology for phenomena definitions is presented in ANNEX C clause 3

– the value of the **procedure** is the description of a process used for the observation

General **eventParameters** allow other aspects of the observation event to be described.

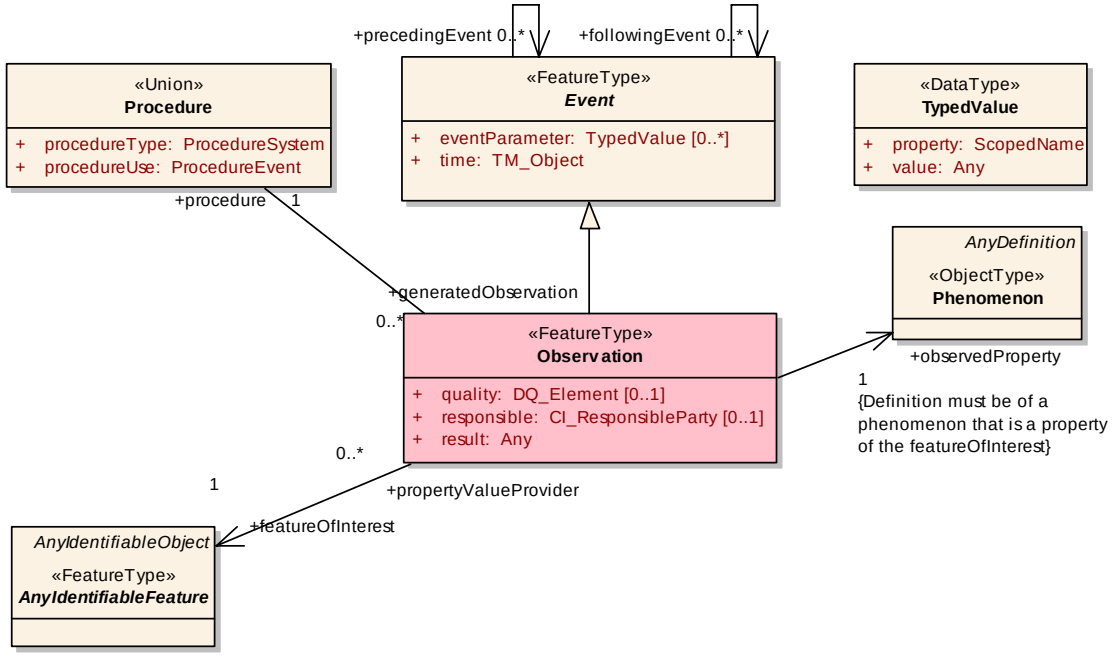

Figure 1. The basic Event and Observation feature types

6.4 Feature of interest and observed property

An observation serves as a **propertyValueProvider** for a feature of interest. The details of the observation event are usually of interest in applications where an evaluation of errors in the estimate of the value of a property is of concern. Thus, the Observation could be considered to carry “property-level” instance metadata, which complements the dataset-level and feature-level metadata that have been conventionally considered (e.g. ISO 19115).

The type of the feature of interest is defined in an application schema (ISO 19109). The feature type determines its set of properties, which for the current purposes may be divided into those properties assigned by some rule or assertion (e.g. name, ownership), and those properties whose value is determined (or estimated) by observation. In order to be coherent with the type of the feature of interest, the value of the observed property for any associated observation must be a phenomenon which is a valid property of the feature of interest.

Example: A feature type “PhysicalSpecimen” may be defined as having the attribute “mass” of type “Measure”. An observation providing the value of this property must have observedProperty=“mass”, the result must be of type “Measure” and the scale (unit of measure) must be suitable for mass measurements.

The description of the phenomenon will often be persisted in a dictionary (e.g. an ISO 19135 Register) and its identifier or designator used as the value of a reference within the observation instance. The persisted description instantiates GF_PropertyType (ISO 19109).

NOTE: Treating the property as a first-class object is an important characteristic of knowledge-representation technologies, such as [RDF]. In the semantic web context, either an object or property may be identified by a URI.

The ultimate feature of interest of an investigation is usually of a type defined in a domain-specific application schema. However, an observation processing chain may involve a series of transformations of the result in parallel with transformation of the semantics of the observed property, which may imply a change in the feature of interest between steps. When considering the different stages of processing, the proximate feature of interest of an observation must be consistent with the result, i.e. at each step the feature of interest must carry the observed property as part of the definition of its type. A feature of the correct type must be identified as the feature of interest.

Example: elements of an optical sensor system may measure photon intensity (feature of interest: sensor focus or ambiguity space), then different sensor bands combined to get a colour spectrum or radiance (feature of interest: pixel or scene), then an algorithm used to obtain a vegetation index (feature of interest: landcover tract).

If realised explicitly, the observations associated with the primitive, intermediate and final results comprise a sequence of events related to each other as preceding and following events.

While the ultimate feature of interest may be a “natural” feature recognised from the application domain (e.g. river, road, person, vehicle, building, mountain, aquifer, etc), the proximate or intermediate target of an observation is often an artefact of sampling (e.g. specimen, station, traverse, pixel, swath etc). A schema for feature types corresponding to sampling artefacts is presented in clause 7.

6.5 Result type and observation specializations

6.5.1 General

The observation result type must be suitable for the observed property.

6.5.2 Constant properties

If a property is single-valued on the feature of interest, the corresponding observation result is a scalar (e.g. mass, length, temperature), or a record whose components correspond to a thematic decomposition of the observed property (e.g. bands of a spectrum, components of a wind-velocity vector, components of a stress tensor).

Specialized observation types may be defined in which the generic result property is overridden specific types (e.g. Figure 2). Note, in particular, the **ComplexObservation** in which the result is a **Record** (ISO 19103). The **resultDefinition** provides a slot where details of the result structure may be provided (RecordType—ISO 19103). This is necessary to augment the type of the result and defines the components and their order. This is effectively a local schema for the result.

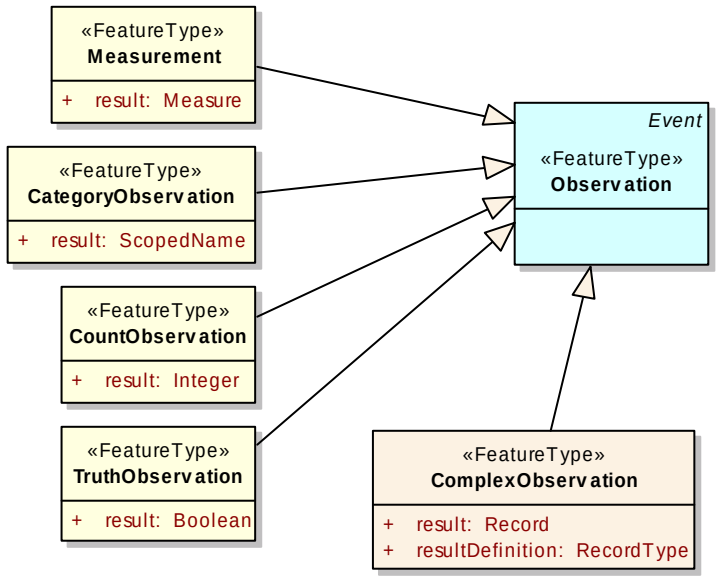

Figure 2. Observation types specialized by result type

6.5.3 Varying properties

If the type of a feature allows for a property that varies temporally or spatially, then the value of the property is a *coverage* (CV_Coverage—ISO 19123) whose domain is the spatio-temporal extent of the feature. The value of a corresponding observation result must also be a coverage. However, while the description of the domain extent is inherent in the description of the feature of interest, the result of a practical observation will *sample* the relevant axis of the target feature, resulting in a *discrete* coverage (CV_DiscreteCoverage).

NOTE: ISO 19123 describes a coverage as being composed of a set of CV_DomainObjects with the role of domainElements and a set of CV_AttributeValues with the role of rangeElements. The domain elements and range elements provide values for the geometry and value attributes (respectively) of a collection of CV_GeometryValuePair elements of a discrete coverage. These two viewpoints correspond with "map" and "interleaved" encodings.

The target feature may have many observations made on it using different sampling regimes, so it is usual for the sampling regime to be captured within the description of the observation, rather than in the description of the feature of interest. This is accommodated by making the decomposition of the domain geometry (i.e. the CV_DomainObject elements) explicit in the observation result. A compact discrete coverage result structure also provides a description of the map between domain and range elements.

Example: The colour of a scene varies with position.The result of an observation of the property"colour"of the scene is a coverage. Each domain element is a pixel whose index allows the spatial location within the scene to be obtained.

Example: Many properties of an observation-well vary along its length, including rock-type, orientation, permeability etc. These are conventionally encoded as "logs". A well-log is a coverage whose domain is the curve describing the shape of the well. The domain is sampled with elements whose location is described in terms of 1-D position measured along the well axis.

A familiar simple case concerns sampling a property at points on an extensive feature. The observation result is a set of point-value pairs (CV_PointValuePair—Figure 3).

An important and common special case of this concerns monitoring a time-varying property by sampling at discrete points in time. The observation result is a set of time-value pairs (CV_TimeInstantValuePair—Figure 3).

Example: An air- or water-quality monitoring station observes properties such as ozone, turbidity, etc. The instantaneous value is a scalar concentration or index value. However, the value will vary during a time period. The value is a coverage whose domain is the period of interest. This is usually described as a time series, which is a discrete time coverage.

Another common case is where the feature of interest is structured into elements, such as an array of stations. In this case the elements of the target feature are responsible for the decomposition of the domain geometry. The result of an observation on a compound feature is a set of element-value pairs (CV_ElementValuePair—Figure 3), in which the domain object refers to a feature, which must be an element of the compound feature that is the feature of interest of the observation.

Example: A temperature field may be sampled using an array of weather stations. The field may be represented as a discrete spatial coverage,whose domain-elements are provided by the individual station locations. However, it is often convenient to use the station identifier as a proxy for location. This is supported by allowing the domain elements to carry feature identifiers in place of spatial designators.

NOTE: ISO 19123 allows for a domain object to be parameterized by space and time. The use of a feature as the domain object is thus a variation on the standard coverage model. In this usage the feature is playing a similar role as an index from a grid domain – it is a designator that supports the relevant spatio-temporal position being obtained indirectly.

Specialized observations with coverage results may be defined (Figure 4). The resultDefinition holds a RecordType definition (ISO 19103), which is the schema that defines the structure of the Record that is the "value" in the geometry-value pair.

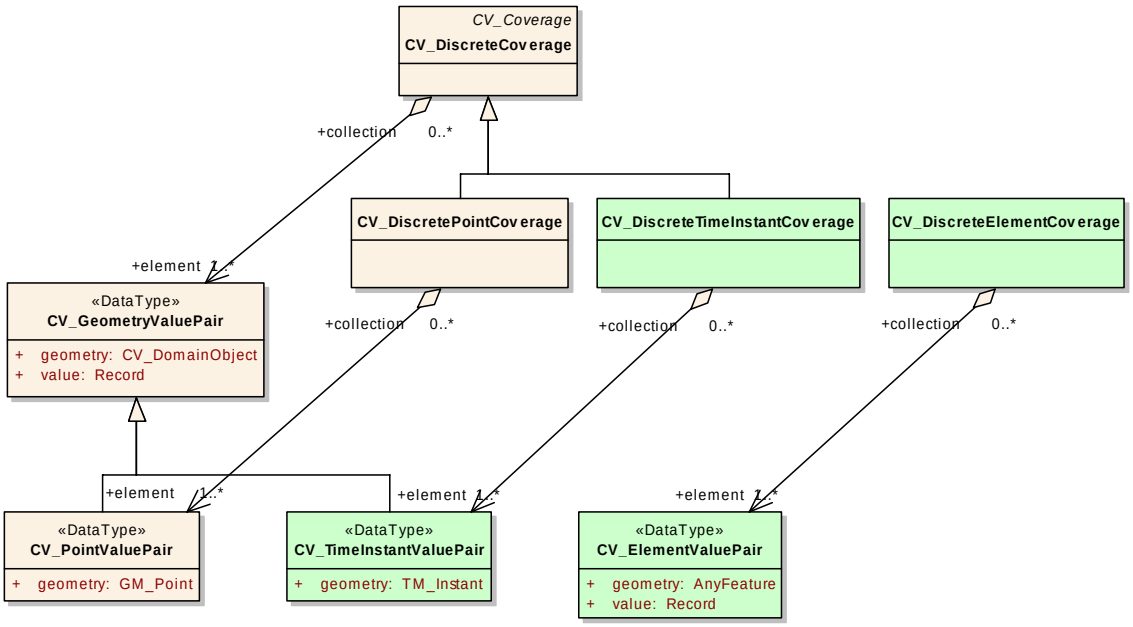

Figure 3. Discrete coverage model and specializations important for observation results

NOTE: CV_DiscreteTimeIntervalCoverage, CV_DiscreteElementCoverage, CV_TimeInstantValuePair and CV_ElementValuePair are extensions to the ISO 19123 coverage model.

NOTE: XML implementations of the coverage models is presented in ANNEX D clause **Error! Reference source not found.**.

NOTE: There are a number of potential alternatives to the schema shown here, including the data definition components from Sensor Model Language and Transducer Markup Language.

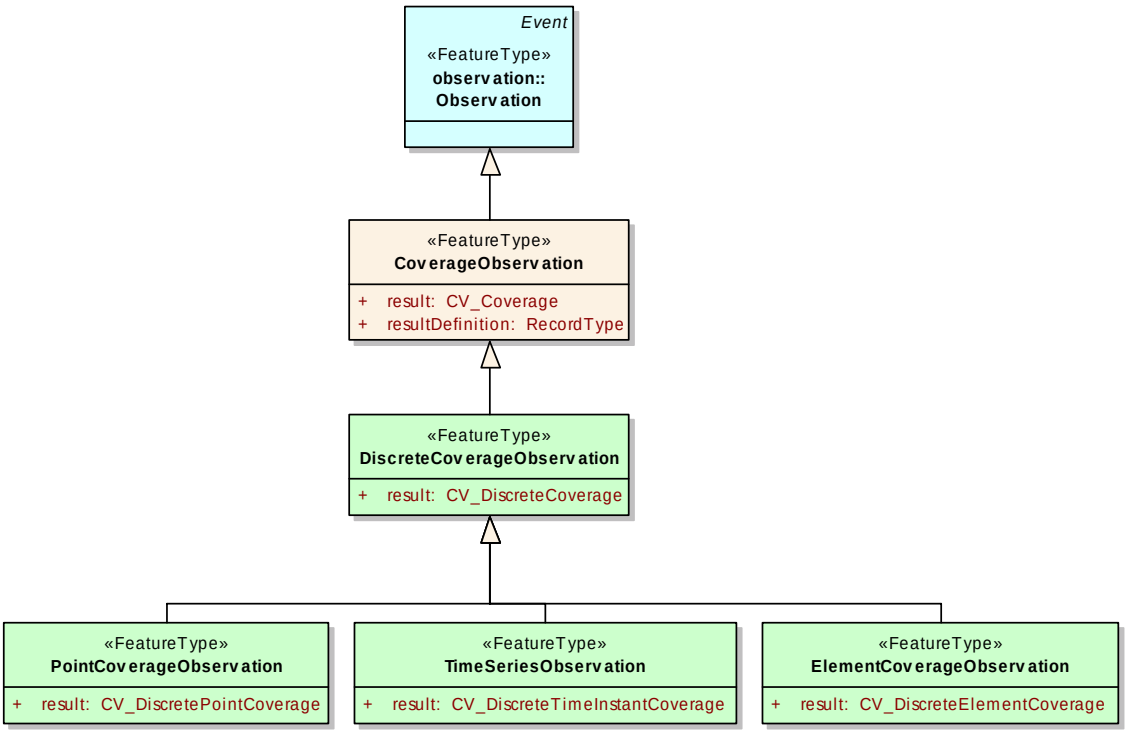

Figure 4. Coverage observations

6.6 Observation procedure

The value of the procedure is a description of the process used to obtain the result. This is often an instrument or sensor, but may be a human observer, a simulator, or a process or algorithm applied to more primitive results used as inputs.

Two forms of description are identified:

– a **ProcedureSystem** describes a generic procedure, with the parameters that apply to the use of the procedure for many observations. Commonly, the description of a procedure system will be recorded in a standard location (e.g. ISO 19135 register) and included by reference. If event-specific parameters related to the use of the procedure are required (e.g. instrument settings, input values), they may be bound to the observation event as **eventParameter** properties

NOTE: In SensorML this is referred to as a “sensor-system”.

– a **ProcedureEvent** describes a procedure including both generic aspects and all event-specific parameters and settings. A procedure event is unique to a single observation, so will be available only in conjunction with an observation description, either inline or by request from the observation-provider. In this case the complete event-description is spread across both the observation and its procedure.

NOTE: SensorML describes a procedure as a process-chain. In cases when this includes parameters and settings associated with the use of a sensor for a single observation event, it corresponds to a procedure event.

NOTE: A simple taxonomy of procedures is presented in ANNEX C clause 4

There are dependencies between the procedure and other observation properties as follows:

– the procedure must be appropriate for the observed property;

– as a corollary, details of the observed property are constrained by the procedure used;

Example: an observed radiance wavelength is determined by the response characteristics of the sensor.

– the procedure, perhaps with event-specific parameters, may provide key parts of the intrinsic description of the feature of interest;

Examples: sampling depth within an observation well; ground location of a target (remote sensing observations)

Notwithstanding the dependencies, it is useful to separate procedure, observed property and feature of interest and represent them as primary properties of an observation. This is because they support classification of the observation in a way that is useful for discovery and retrieval.

6.7 Location

Observation "location" is ambiguous. The location relevant to spatial analysis of processed observation results is usually (i) the sampling location of the ultimate feature of interest of the fully processed observation. However, other locations are relevant in observation processing. These may include (ii) the location of the proximate feature of interest (see sub-clause 6.4); (iii) the location of sensor at the time of the observation event—this may be distant from the feature of interest (remote sensing) or from its sampling location (e.g. laboratory observations of physical specimens removed from the wild); and (iv) the current location of the feature of interest—this may be different from the sampling location (e.g. physical specimens). Type (i) location may not be available at early stages of data processing.

For these reasons, the generic Observation class does not have an inherent property corresponding to location. Relevant location information is provided explicitly by the description of the feature of interest, or by the observation procedure.

6.8 Collections of observations

An **ObservationCollection** is composed of a set of member observations (Figure 5). The time associated with the collection is the period including the times of all members.

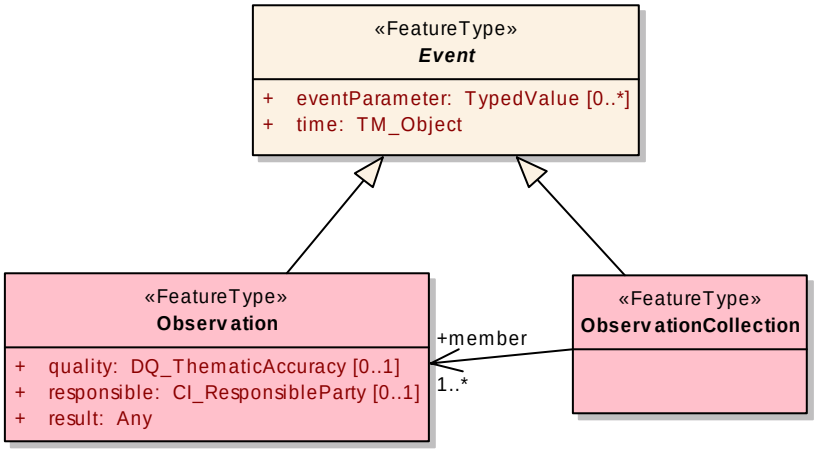

Figure 5. Observation collection

Under certain conditions of homogeneity, the information in an observation collection may be captured in a compound observation types, as described in sub-clause 6.5.

All member observations must have

– the same responsible party

If the member observations have

– the same feature of interest

– the same event time

– different observed properties

this may be represented as a ComplexObservation (sub-clause 6.5.2) whose observed property compounds the individual properties.

Examples: a multi-band spectral radiance; a compound observable like "weather"; a tensor property like earthquake moment.

If the member observations have

– the same feature of interest

– the same observed property

– different event times

this may be represented as a TimeSeriesObservation (sub-clause 6.5.3) whose event time is the period encompassing all the member times.

Examples: air-temperature at a weather station; water quality observations at a water monitoring station.

If the member observations have

– the same observed property

– the same event time

– features of interest that comprise elements of a larger feature

this may be represented as a DiscreteCoverageObservation (sub-clause 6.5.3) whose feature of interest is the larger feature and within which the result elements' geometry describe its spatio-temporal decomposition.

Example: the feature of interest is an array of stations, which may be on a grid; or an array of pixels, which comprise a scene

6.9 Implementation strategies

The O&M model is presented using the UML profile described in ISO 19103 and ISO DIS 19136. This allows a GML Application Schema to be generated by following the encoding rules in ISO DIS 19136. This implementation represents the model explicitly, with elements that carry the names that appear in the model. The schema is presented in ANNEX D.

NOTE: The direct encoding requires some adjustments to accommodate the fact that the model shows attributes in specialized classes with types that override those in the parent class. A direct implementation implies use of the XML Schema "restriction" mechanism which is inconsistently implemented by standard processors, and thus explicitly disallowed in the encoding rules. The XML implementation in ANNEX D introduces additional Abstract classes but this does not impinge on the conceptual models shown here.

Alternative GML Application Schema implementations are possible, and may be considered conformant provided they accommodate the information items identified in the model. The model may also be used to design or analyse implementations using other platforms, such as tables, spreadsheets, etc.

Note that a GML implementation is necessary to allow O&M objects to be represented in a form that conforms with requirements for service interfaces specified by OGC, in particular WFS and profiles of WFS.

7 Sampling features

7.1 Feature of interest

The feature of interest of an observation may be any feature having properties whose values are discovered by observation. In general, this will be of a type from catalogue representing the application domain for an investigation [ISO 19109, ISO 19110].

Nevertheless, certain feature types are only associated with sampling, and have no significant function outside of their role in the observation process. These include stations, profiles, swaths, scenes, specimens, and various specializations of these. The physical characteristics of these features themselves are of little interest. For example, a "station" is merely an identifiable locality where a sensor system or procedure may be deployed and an observation made. In the context of the observation model, it connotes the "world in the vicinity of the station", so the observed properties relate to the the world, and not to a physical artefact such as a mooring, benchmark, monument, well, etc.

Feature types having this behaviour are similar across all application domains, so this clause describes a common model.

7.2 Basic Sampling Feature

The base model for sampling features is shown in Figure 6. The base class is defined primarily by a set of **relatedObservation** associations. As a corollary, a sampling feature has a set of soft-typed **property** attributes.

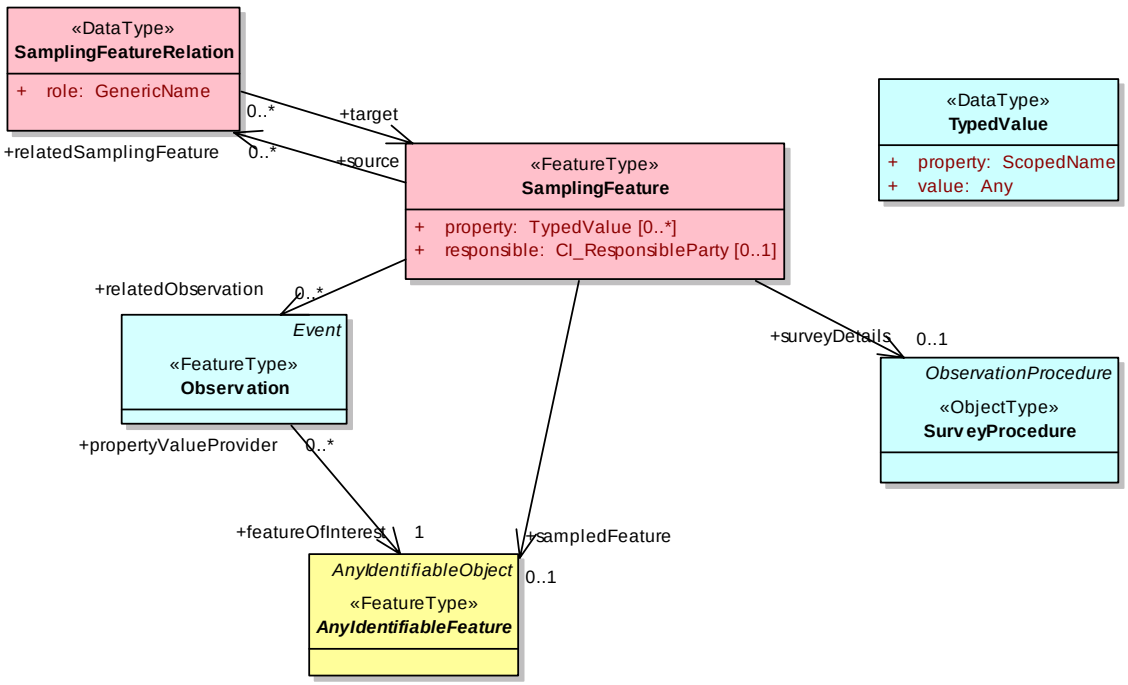

Figure 6. Sampling feature model

A sampling feature is commonly associated with a domain feature. This is supported through the **sampledFeature** association.

Examples: a sounding typically samples a water- or atmospheric-column; a well samples an aquifer; a tissue specimen samples a part of an organism

Sampling features are frequently related to each other, as parts of networks, through sub-sampling, etc. This is supported by the **relatedSamplingFeature** association with a generic **SamplingFeatureRelation** association class, which carries a **source**, **target** and **role**.

A common requirement for sampling features is an indication of the **SurveyProcedure** that provides the **surveyDetails** related to determination of its location and shape. The SurveyProcedure class is described in ANNEX C clause 4.2.

7.3 Extensive sampling features

A hierarchy of sampling feature types may be organized on the basis of the dimensionality of their extent (Figure 7). A **Station** samples the world at a point, a **Profile** along a curve, a **SurfaceOfInterest** on a surface, and a **SolidOfInterest** in a solid region.

NOTE: In ISO 19109 sub-clause 8.6 Figure 17 shows a model of a Station and its associated Measurements as an example application schema.

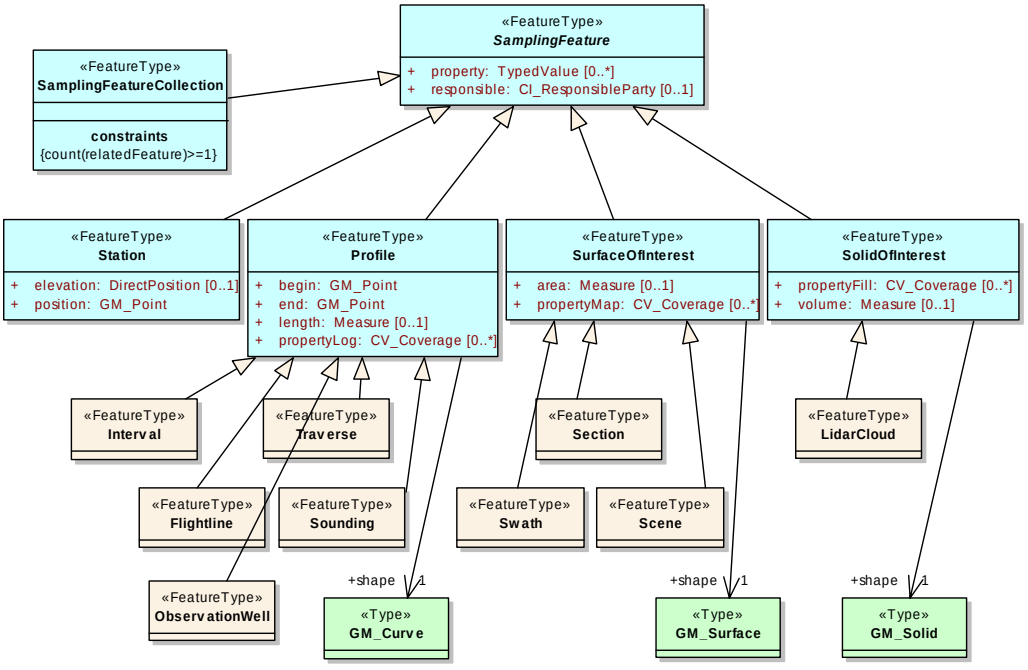

Figure 7. A hierarchy of site types used for observation sampling.

NOTE: Some common names used in application domains to denote sampling features include Flightline, Interval, LidarCloud, ObservationWell, Scene, Section, Sounding, Swath, and Traverse. These are shown as specialized feature types, for illustrative purposes only, in the lower part of Figure 7.

As well as the generic soft-typed **property** inherited from SamplingFeature, extensive sampling features carry properties whose values are coverages on the primary feature extent. Along a curve this is conventionally a **propertyLog**; on a surface it is designated **propertyMap**; in a solid it is a **propertyFill**.

7.4 Specimen

A **Specimen** (Figure 8) is a physical sample, characterized by having a **currentLocation** (e.g. its storage location) and an indication of its **currentSize** (e.g. mass), and its gross **materialClass** (e.g. soil, water, rock, tissue, etc).

In many applications a specimen preparation procedure is applied to the material prior to its use in an observation. This may be recorded as part of the analytical procedure, or may be associated with the specimen. The **preparationDetails** property supports the latter pattern. For further details concerning procedures, see ANNEX C clause 4.

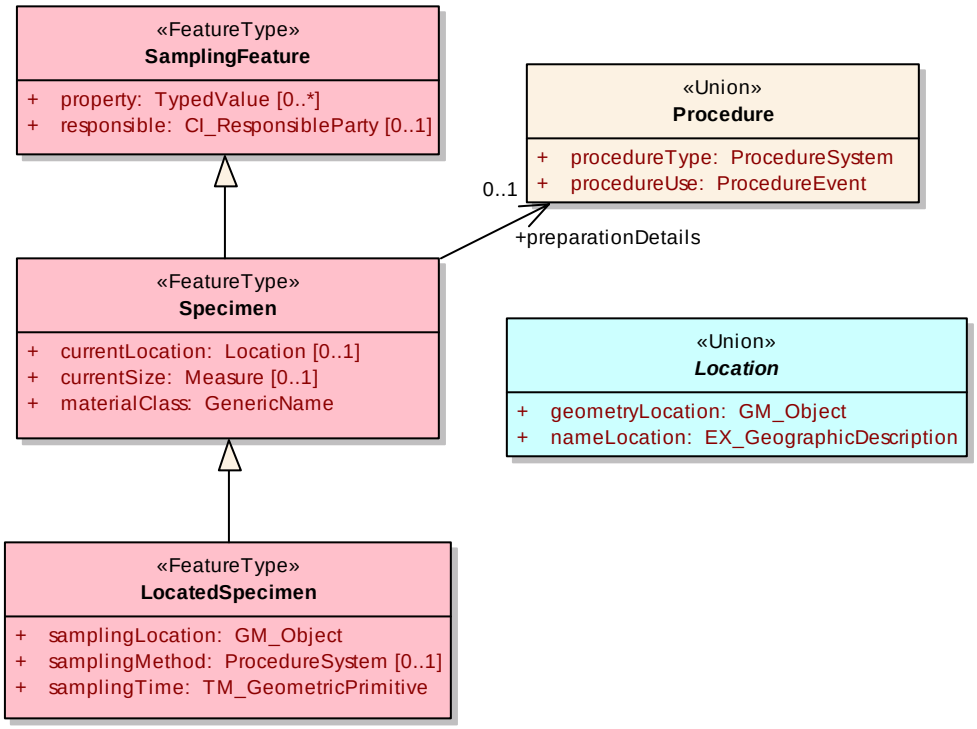

Figure 8. Specimen model

A **LocatedSpecimen** is a specialization that adds information about the sampling-location, time and method.

7.5 XML Implementation

An explicit XML implementation of the sampling features model as a GML Application Schema is presented in ANNEX D clause 3.

8 Discussion

8.1 Feature of interest

Application of the Observations and Measurements model requires careful attention to identify the feature of interest correctly. This may be straightforward if the observation is clearly concerned with an easily identified concrete feature type from a domain model. However, in some cases the assumed feature of interest may turn out to be ultimate, rather than proximate. And in some cases a careful analysis reveals that the type of the feature of interest is something that had not previously been identified in the application domain.

The proximate feature of interest must be capable of carrying this result as the value of a relevant property. So a useful approach is to consider what the *result* of the observation is, and then the feature of interest may be deduced since it must have a property with this result as its value. If an observation produces a result with several components, or if there are a series of related observations with different results, then this may help further refine the understanding the type of the true feature of interest.

Example: in monitoring situations, the feature of interest is often a typed event or “occurrence”. The observation procedure(s) provides an estimate of (i) time, (ii) location, and (iii) type (e.g. species, identity) of the party involved.

8.2 Domain specialization

Specialization of the observation model for an application domain is accomplished primarily through its application schema and feature-type catalogue. For example, an instance of a feature-type in the domain application schema will provide the ultimate feature of interest for the investigation of which the observation is a part. A description of a sensor or process familiar within the application domain is the value of the observation procedure. The model encourages encapsulation of domain specialization in the associated classes, and the observation class itself rarely needs specialization.

Nevertheless, other choices can be made in partitioning information between the classes in the model. For some applications it may be convenient for information that is strictly associated with a second-layer object (procedure, feature of interest) to be associated with a specialized observation type.

For example, in applications measuring chemistry or contamination, the process often involves retrieving specimens from a sampling station, which are then sent to a laboratory for analysis. The specimen is a very tangible feature instance, with identity. For some applications it may be important to recognize the existence of the specimen, and retain a separate description of it. However, in other applications, particularly when the focus is on monitoring the change in a determinand at a sampling station, the existence of a series of distinct specimens is of minor or no interest. In this case creating a series of objects and identifiers is superfluous to the users.

Nevertheless, some properties that might be strictly associated with the specimen must still be recorded, such as “sampling elevation” in a water or atmospheric column . A number of choices may be made. For example, elevation could be

(a) a property of each distinct specimen on which the atomic observations are actually made,

(b) a property of the sampling station (which would require a distinct station to be described for observations at other elevations),

(c) a parameter of the observation procedure, (which makes the procedure description specific to this observation series only) or

(d) a parameter of the observation event, either using the standard “soft-typed” eventParameter, or through specialization of the observation type.

Any of these is a legitimate approach. The optimum one will be dependent on the application.

All of the classes in the models presented here for observations and procedures may be further specialized for domain-specific purposes. Additional attributes and associations may be added as necessary.

Example: “Assay” may be derived from Measurement, fixing the observedProperty to be “ChemicalConcentration” and adding an additional attribute “analyte”.

8.3 Comparison with provider-oriented models

The O&M model was not designed solely, or even primarily, for a GML implementation. It is intended to provide a basic output- or user-oriented information model for sensor web and related applications. The goal is to provide a common language for discourse regarding sensor and observation systems.

In comparison, TML and SensorML have process- or provider-oriented data models. These are usually used to describe data at an early stage in the data processing and value-adding chain. This may be prior to the details of the ultimate feature-of-interest and observed property being assembled and assigned to the result, in a way that carries the key semantics to end-users of observation data. In particular, part of a TML or SensorML datastream may include information that must be processed to determine the position of the target or feature-of-interest. At the early processing stage such positional and timing information may be embedded within the result.

Nevertheless, even within these low-level models the O&M formalization may be applied. The proximate feature-of-interest is the vicinity of the sensor. The observed property is a composite phenomenon including components representing observation timing, and position and attitude of a sensor, etc. This must be processed to obtain the details of the ultimate feature of interest. The procedure is a sensor package including elements that capture all of the elements of the composite phenomenon, etc.

8.4 Observation discovery and use

The Observation and Measurements model presented here offers a user-oriented viewpoint. The information object is characterized by a small set of properties, which are likely to be of interest to a user for discovery and request of observation data. The user will typically be interested primarily in a feature of interest, or the variation of a phenomenon. The model provides these items as first order elements. An interface to observation information should expose these properties explicitly.

Sensor Observation Service [SOS] leverages the O&M model directly, with *featureOfInterest* and *property* being (1) explicit classifiers for an observationOffering in the capabilities description, used for discovery, and (2) explicit parameters in the GetObservation request. From a user point of view, the sensor or procedure description is primarily *metadata*, which is only of interest to specialists during discovery, and then to assist evaluation or processing of individual results.

Each of these associated objects (sensor or procedure, target feature, phenomenon) may require a complex description. Hence they are modelled as distinct classes, which may be as simple or complex as necessary. In the XML serialized representation following the GML pattern, they may appear inline, perhaps described using one of the models presented here, or they may be indicated by reference using a URI. The URI identifier may be a URL link or service call, which should resolve immediately to yield a complete resource. Or it may be a canonical identifier, such as a URN, which the user and provider are preconfigured to recognise and understand.

On the other hand, TML and SensorML take a process- or provider-oriented viewpoint. Discovery and request is based primarily on the user having knowledge of specific sensor systems and their application. While this is a reasonable assumption within technical communities, specialist knowledge of sensor systems would not be routinely available within a broader set of potential users of sensor data, particularly as this is made widely available through interfaces like SOS.

8.5 Observations vs. Interpretations

Some conceptual frameworks make a fundamental distinction between *observations* and *interpretations* as the basis for their information modelling approach. This supports a pattern in which observations are given precedence and archived, while interpretations are more transient, being the result of applying the current algorithms and paradigms to the currently available observations.

An alternative view is that the distinction is not absolute, but is one of degree. Even the most trivial "observations" are mediated by some theory or procedure. For example, the primary measurement when using a mercury-in-glass thermometer is the position of the meniscus relative to graduations. This allows the length of the column to be estimated. A theory of thermal expansion plus a calibration etc allows conversion to an inferred temperature. Other observations and measurements all involve some kind of processing from the primary observable. For modern instruments the primary observable is almost always voltage or resistance or frequency from some kind of sensing element, so the

"procedure" typically involves calibrations, etc, built on a theory of operation for the sensor. But the same high-level information model - that every "value" is an estimate of the value of a property, generated using a procedure and inputs - applies to both "observations" and "interpretations". It is just that the higher the semantic value of the estimate, the more theory and processing is involved.

In some cases it may be useful to explicitly describe the processing chain instance that has taken a more primitive observations (e.g. an image) and retrieved a higher level observation (e.g. the presence of a certain type of feature instance) through the application of one or more processing steps.

8.6 Features, coverages and observations – different views of information

ISO 19109 describes the *feature* as a “fundamental unit of geographic information”. The “General Feature Model” (GFM) presented in ISO 19101 and 19109 defines a feature type in terms of its set of properties, including attributes, association roles, and behaviours, as well as generalization and specialization relationships, and constraints.

Typical concrete feature types have names like “road”, “watercourse”, “mine”, “atmosphere”, etc. For a road the set of properties may include its name, its classification, the curve describing its centreline, the number of lanes, the surface material, etc. The complete description of a road instance, therefore, is the set of values for the set of properties that define a road type. This use of the feature model is object-centric, and supports a viewpoint of the world in terms of the set of discrete identifiable objects that occupy it.

The principle alternative model for geographic information is the *coverage*, described in ISO 19123. This viewpoint focuses on the variation of a property within the (spatio-temporal) domain of interest. The domain may be a grid, a transportation network, a volume, a set of sampling stations, etc. The range of the coverage may be any property, such as reflectance, material-type, concentration of some pollutant, number of lanes etc. But the key to the coverage viewpoint is that it is property-centric, concerning the distribution of the values of a property within its domain space.

These viewpoints are not exclusive, and both are used in analysis and modelling. For example, a feature may be detected from analysis of variation of a property in a region of interest (e.g. an ore-body from a distribution of assay values). And for some feature types, the value of one or more properties may vary across the feature, in which case the shape of the feature provides the coverage domain (e.g. ore-grade within a mine).

Observations focus on the data collection event. An Observation event serves to assign a value to a property of a feature. If the property is non-constant, the value may be a coverage. The results of a set of observations of different properties on the same feature of interest may provide a complete description of the feature instance. Alternatively, the results of a set of observations of the same property on a set of different features provide a discrete coverage of that property over a domain composed of the geometry of the feature set. The other properties of the Observation are metadata concerning the estimation of the value(s) of a property on a feature of interest.

In particular, Observations concern properties (e.g. shape, color) whose values are determined using an identifiable procedure, in which there is a finite uncertainty in the result. This may be contrasted with properties whose values are specified by assertion (e.g. name, owner) and are therefore exact. The observation instance provides “metadata” for the property value-estimation process.

However, an observation event is clearly a “feature” in its own right, according to the GFM definition. An observation event is a useful unit of information, therefore observation event is a feature type.

In sub-clause 6.8 we discussed equivalences of certain observation collections with complex observations, and with observations whose result is a coverage. Transformation between viewpoints is frequently required. OGC AS Topic 6 comments: “we should be comfortable moving back and forth between any of the [different representations of the same information] whenever it makes sense to do so”. Some of the observation specializations provide an explicit demonstration of the transformation.

This is illustrated in Figure 9, which schematically shows a dataset comprising values of a set of properties at a set of locations. A row of the table provides the complete description of the properties at a single location. This is a potential representation of a feature description. A column of the table describes the variation of a single property across the set of locations. This is a representation of a discrete coverage. A single cell in the table provides the value of a single property on a single feature. This is often the result of an observation.

Observations, Coverage and Feature representations may be associated with different phases of the data-processing cycle or value-chain:

– The observation view is associated with data collection, when an observation event causes values for a property of a feature to be determined, and during data entry when the data-store is updated by inserting values into fields in the datastore;

– A coverage view may be assembled from results of observations of a specific property, and represents data assembled for analysis, when the objective is to find signals in the variation of a property over a domain;

– A discrete feature description is a “summary” viewpoint, assembled from results of observation on the same target, or an “inferred” viewpoint, by extraction of a signal from a coverage.

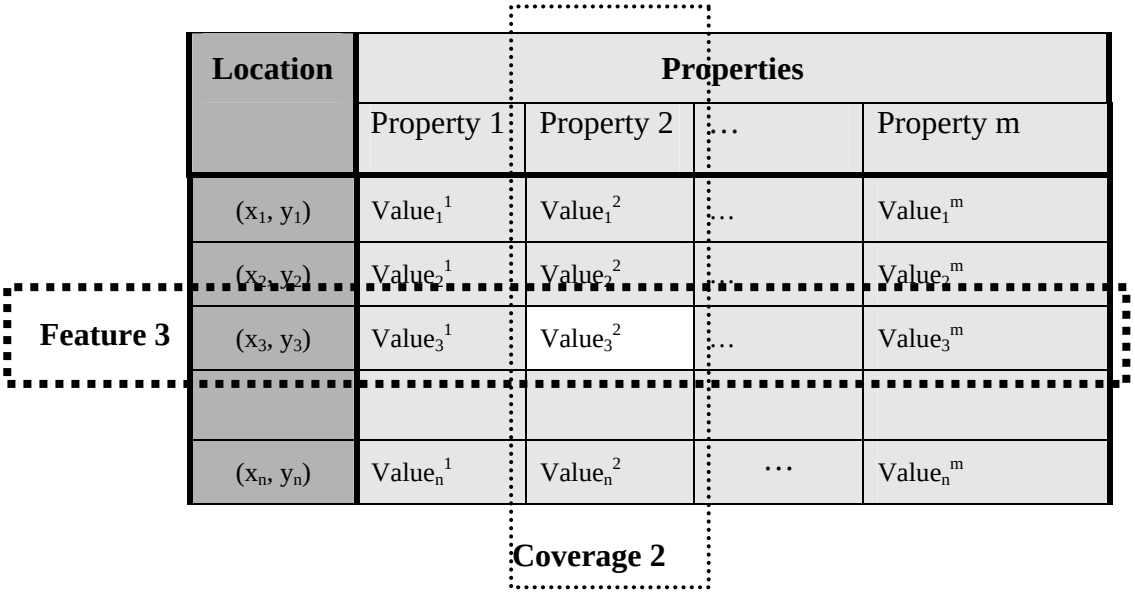

Figure 9. Tabular representation of information associated with a set of locations.

ANNEX A
(normative)

Abstract test suite for Observations and Measurements schemas

TBC

ANNEX B
(informative)

Mapping O&M terminology to usage in some common domains

1 Introduction

This document describes use of terminology in support of a generic, cross-domain model for observations and measurements. This includes terms taken from a variety of disciplines. The terms are used within the model in a consistent manner, but in order to achieve internal consistency, this varies from how the same terms are used in some application domains. In order to assist in the correct application of the model across domains, this Annex provides a mapping from O&M terminology to some domain vocabularies.

2 Earth Observations (EO)

O&M	**EO**
Observation::result	observation value, measurement value
Observation::procedure	method, sensor
Observation::observedProperty	parameter, variable
Observation::featureOfInterest	media (air, water, …), Global Change Master Directory "Topic"

2.1 EO Examples

2.1.1 Air Quality

O&M	**Particulate Matter 2.5 Concentrations**
Observation::result	35 ug/m^3
Observation::procedure	U.S. EPA Federal Reference Method for $PM_{2.5}$
Observation::observedProperty	Particulate Matter 2.5
Observation::featureOfInterest	troposphere

3 Metrology

O&M	Metrology
Observation::procedure	instrument
Observation::observedProperty	measurand
Observation::result	value

ANNEX C
(informative)

The O&M second layer

1 Introduction

O&M describes a generic model for metadata associated with property-value estimation. However, much of the detail in specific observations is associated with classes in the "second layer" – i.e. the features of interest, phenomena, and procedures.

Detailed schemas for the second-layer objects are generally the concern of domain-specific application schemas that utilise O&M. However, some general patterns apply, which are discussed in this clause through schemas for Phenomena and Procedures.

The schemas for Phenomena and Procedures in this Annex are informative, and are provided for convenience only. In the context of Observation instances, both Phenomenon and Procedure are tyically indicated by reference, rather than represented by a complete description "inline". This pattern requires that each instance of these classes has an unambiguous identifier, which is then used in a reference. The reference may also be to a description encoded in another form, including offline. Provided the semantics are correct, then this is consistent with the model. A common pattern, however, is that consistent and well-governed identifiers for Phenomena and Procedures are more immediately important that the full description of these concepts.

2 Feature of interest

In many applications, the type of the feature of interest is supplied by a domain-specific application schema (see discussion in sub-clause 8.1). A cross-domain model for sampling features is given in Clause 7. In contrast with the schemas for Phenomena and Procedures presented in the following sub-clauses, the Sampling Features schema is normative.

3 A Phenomenon schema

3.1 Scope

The observed property is a feature characteristic, the estimation of which is the purpose of the observation. This may be a physical property (such as temperature, length, etc), a classification (such as species), frequency or count, or an existence indication. This is referred to in this specification as a *Phenomenon*, the estimate of whose value is the primary result of the observation.

A schema for semantic definitions of phenomena is beyond the scope of this specification. Ultimately this rests on shared concepts that can only be described in natural language. However, the value of the observed property is a key classifier for the information reported in an observation. Thus, in order to support such classification, for use in discovery and requests, an ontology of observable phenomena must be available.

NOTE: The term "Phenomenon" is sometimes used to refer to transient features, such as lightning or storms. Here it is used as an umbrella term to encompass definitions of any kind of feature property whose value is amenable to observation or estimation, including physical properties, classification axes, existence and occurrence assessments, etc.

Formal notations for knowledge representation are available (e.g. OWL [OWL]) and prototype ontologies for phenomena have been constructed using such technology (e.g. SWEET - see http://sweet.jpl.nasa.gov/ontology/property.owl).

NOTE: SWEET is the most well known ontology for physical properties. However, SWEET is incomplete, and furthermore has limitations in the description of phenomena derived from more basic or atomic components, partly related to OWL's weakness in numerics.

NOTE: EDCS "Attributes" [ISO/IEC 18025] is another formal dictionary of observable phenomena.

3.2 Derived phenomena

In order to support common uses in natural sciences and engineering, we provide a schema which supports the description of "derived" phenomena definitions. This requires a pre-existing set of definitions of "fundamental" phenomena to be used as the base phenomena, and for the semantics of axes of constraint for derived phenomena.

NOTE: The set of "quantity types" used in the definition of units of measure (e.g. SI) may be used as basic physical properties, but this does not exhaust the base phenomena required to characterize observations.

A schema for derived phenomena definitions is shown in Figure 10. This may be considered primarily as a description of *requirements* for a phenomenon ontology, though it may also be implemented as a GML Application Schema following the usual encoding rules.

The description of the phenomenon will often be persisted in a dictionary (e.g. an ISO 19135 Register) and its identifier or designator used as the value in the observation instance. The phenomenon description effectively instantiates GF_PropertyType (ISO 19109).

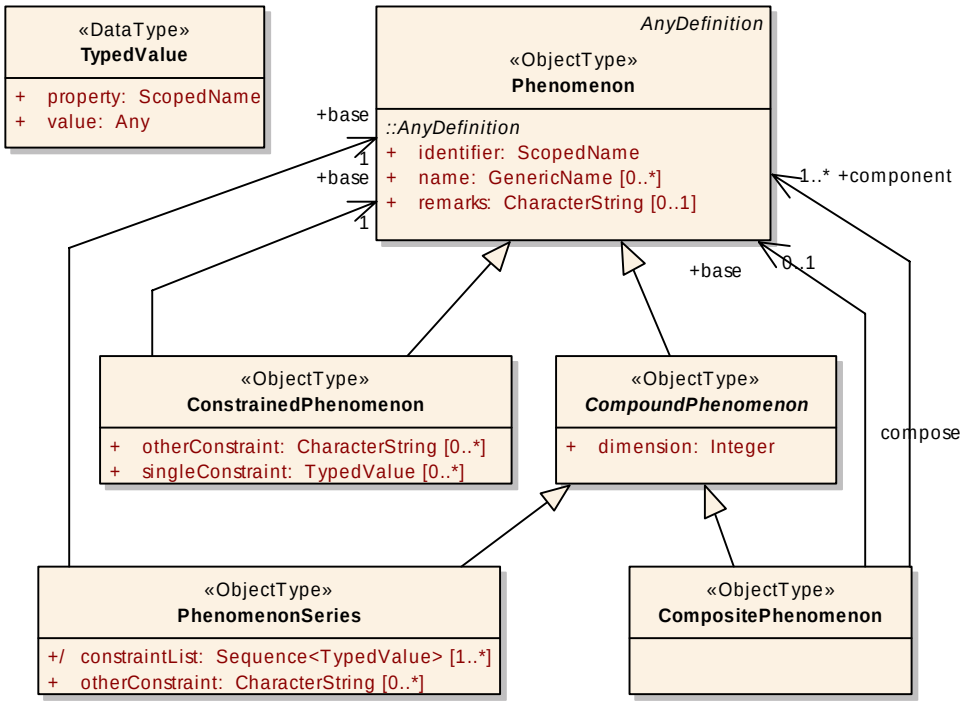

Figure 10. A taxonomy of phenomenon definitions

The basic **Phenomenon** class is a definition, with an identifier and an optional set of aliases.

Two kinds of specializations are supported: constraints and compounding.

A **ConstrainedPhenomenon** modifies a **base** phenomenon by adding **singleConstraint**s, each specifying a value on some secondary axis.

Example: “water temperature” has the base “temperature” (i.e. it is a kind of temperature) constrained so that the property “substance” has the value “water”. “Surface water temperature” might add another constraint that “depth” is “between 0 - 0.3m”.

A **CompoundPhenomenon** has several components, whose count is indicated by the **dimension**. CompoundPhenomenon is an abstract class. Two concrete specializations are provided.

A **CompositePhenomenon** is composed of a set of **component** phenomena. The components may not be related to each other, though useful compound phenomena would usually have some semantic coherence. The optional **base** phenomenon allows for the CompositePhenomenon to be generated by adding components to a base.

A **PhenomenonSeries** applies one or more **constraintList**s to the base phenomenon, each providing a set of values for a single secondary axis.

Example: A “radiance spectrum” may be based on “radiance” with a list of “wavelength” intervals specified.

The “base” association indicates a conceptual relationship, which may be useful in classification of observation types. The value of a specialised phenomenon must be described using a scale (units of measure, vocabulary) that could also be used for the base.

Example: an application may choose to include observations of “WaterTemperature” when the subject of interest is observations of “Temperature”.

3.3 XML Implementation

An explicit XML implementation of the Phenomenon model as a GML Application Schema is presented in ANNEX D clause 5.

A sample phenomenon dictionary in **Error! Reference source not found.**.

4 A basic Procedure schema

4.1 Scope

The detailed description of procedures is beyond the scope of this specification. One generic schema for observation procedures is provided by SensorML. In SensorML the procedure is characterized functionally, as a process chain. Other descriptions of observation procedures may be preferred in a particular context.

However, a high-level classification of procedure types was introduced in sub-clause 6.6, distinguishing between reusable (ProcedureSystem) and specific (ProcedureEvent) procedures. The remainder of this sub-clause describes some further elaborations of this model.

4.2 High level procedure hierarchy

A framework for generic procedures is shown in Figure 11.

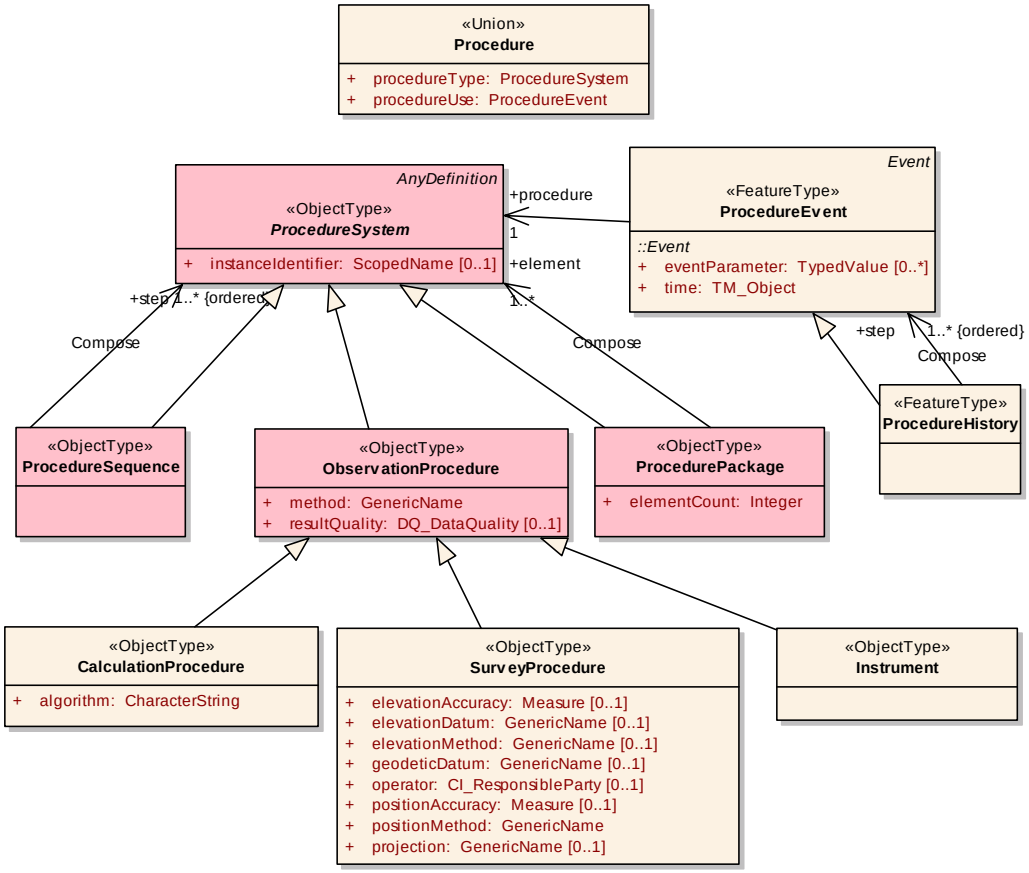

Figure 11. High-level procedure hierarchy, with specializations relevant to observations.

A procedure is generally an abstraction, for which the description or catalogue entry provides the canonical object. Hence, the abstract superclass **ProcedureSystem** is defined as a specialized definition, and is stereotyped <<ObjectType>>. A specific instance of a system may be indicated using the instanceIdentifier property. This may be used to hold an instrument serial number (for example).

A **ProcedureSequence** is a single procedure composed of an ordered set of **steps**, the value of each being a ProcedureSystem. A ProcedureSequence generates a simple result.

NOTE: A SensorML document describing a sensor-system is typically an implementation of a ProcedureSequence.

A **ProcedurePackage** is a single procedure composed of **elements** each responsible for a different observed property or component. A ProcedurePackage generates a complex result representing the value of a compound phenomenon.

Example: The set of instruments at a weather station is a common example of a procedure package. Separate elements measure temperature, wind-speed, pressure, etc, providing a complete description of the weather as a compound phenomenon

An **ObservationProcedure** is characterized by a **method**, and a **resultQuality** that is associated systematically with the results of observation made using this procedure. The "method" will typically be a code from some catalogue.

Three specializations of ObservationProcedure are shown. An **Instrument** is a physical artefact used for generating observations. A **CalculationProcedure** is a data-processing or simulation procedure. A **SurveyProcedure** is used for observations of shape and location. The requirement for this class was introduced in the context of sampling features (Clause 7).

A **ProcedureEvent** binds a ProcedureSystem to a time, and allows event-specific parameters to be recorded. A ProcedureHistory is a specialized ProcedureEvent, composed of an ordered sequence of ProcedureEvents.

NOTE: A SensorML document may be a description of a ProcedureHistory.

The union class **Procedure** serves to provide a choice of either ProcedureSystem or ProcedureEvent. This is the target of the association with the Observation class.

4.3 XML Implementation

An explicit XML implementation of the Procedure model as a GML Application Schema is presented in ANNEX D Clause 2.

5 Result types

The Observation class allows for a result whose type is specified in the instance. Any datatype known to the application may be used, including the basic type libraries provided in ISO 19103 and implemented in part in GML [ISO 19136].

An application schema may define classes to provide the value of a feature property. Following the model described in Clause 6.4 these will provide the type for an observation of the corresponding property.

ANNEX D
(informative)

XML Schema implementation

1 GML Application Schema

The models presented in this specification use the UML profile described in ISO 19103 and ISO DIS 19136. This allows a GML Application Schema to be generated by following the encoding rules in ISO DIS 19136. This implementation provides an explicit representation of the model, with XML elements carrying the literal names that appear in the model.

NOTE: The gml:Observation element provided in ISO 19136 implements a closely related concept. However, gml:Observation does not conform to the model described in this specification in the following ways: (a) the observation target is not constrained to be a feature; (b) the "using" property (corresponding to "procedure") is optional; (c) the observedProperty is not provided.

2 Observations and measurements schema

2.1 Namespace

The Observations and Measurements schema is in the namespace
http://www.opengeospatial.net/om/0.0

2.2 event.xsd

This document implements the class Event described in sub-clause 6.3, and shown in Figure 1.

Listing 1. event.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:gml="http://www.opengis.net/gml" xmlns:gmd="http://www.isotc211.org/2005/gmd"
      xmlns:swe="http://www.opengis.net/swe" xmlns="http://www.w3.org/2001/XMLSchema"
      xmlns:om="http://www.opengeospatial.net/om/0.0" targetNamespace="http://www.opengeospatial.net/om/0.0"
      elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
       <annotation>
            <documentation>event.xsd

Components required to establish the top-level of the om:Event substitution group

Copyright © 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
       </annotation>
       <!-- ================================================================== -->
       <!-- bring in other schemas -->
       <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
       <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
       <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
       <!-- ================================================================== -->
       <!-- ========================================================== -->
```

```
    <complexType name="TimeObjectPropertyType">
        <annotation>
            <documentation>Property type for TM_Object not provided by GML</documentation>
        </annotation>
        <sequence minOccurs="0">
            <element ref="gml:AbstractTimeObject"/>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup"/>
    </complexType>
    <!-- ========================================================== -->
    <complexType name="EventType">
        <annotation>
            <documentation>Event is a feature type [ISO 19101, ISO 19109, OGC AS Topic 0] characterized
primarily by a time whose value is a temporal object (TM_Object—ISO 19108).
            The event time will often be an instant or period (TM_Instant or TM_Period), though it may be
characterised using temporal topology.
            Explicit associations with preceding or following events may also be known.
    Use gml:description to describe the nature of the event or action, or to point to a description of it.
    Head of a substitution group of more specialized events, including Observations. </documentation>
        </annotation>
        <complexContent>
            <extension base="gml:AbstractFeatureType">
                <sequence>
                    <element name="eventParameter" type="swe:TypedValuePropertyType" minOccurs="0"
maxOccurs="unbounded">
                        <annotation>
                            <documentation>Generic event parameter or property</documentation>
                        </annotation>
                    </element>
                    <element name="time" type="om:TimeObjectPropertyType">
                        <annotation>
                            <documentation>The Time when the event occurred (mandatory).
            This may be given
        * in absolute terms as a TimeInstant or TimePeriod
        * in approximate terms or relative to an absolute position using the indeterminatePosition attribute
        * or using a TimeTopology element (TimeEdge or TimeNode), which provides the option of giving a time relative
to other edges or nodes, either directly (gml) or indirectly (xmml)
        * as a TimeGeometricComplex if it is a recurring or repeating event</documentation>
                        </annotation>
                    </element>
                    <element name="precedingEvent" type="gml:StringOrRefType" minOccurs="0"
maxOccurs="unbounded">
                        <annotation>
                            <documentation>Description of, or pointer to, preceding
event(s)</documentation>
                        </annotation>
                    </element>
                    <element name="followingEvent" type="gml:StringOrRefType" minOccurs="0"
maxOccurs="unbounded">
                        <annotation>
                            <documentation>Description of, or pointer to, following event(s)</documentation>
                        </annotation>
                    </element>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <!-- ..................... -->
    <element name="Event" type="om:EventType" substitutionGroup="gml:AbstractFeature">
        <annotation>
            <documentation>Event is a feature type [ISO 19101, ISO 19109, OGC AS Topic 0] characterized
primarily by a time whose value is a temporal object (TM_Object—ISO 19108).
            The event time will often be an instant or period (TM_Instant or TM_Period), though it may be
characterised using temporal topology.
            Explicit associations with preceding or following events may also be known.
    Use gml:description to describe the nature of the event or action, or to point to a description of it.
    Head of a substitution group of more specialized events, including Observations. </documentation>
        </annotation>
    </element>
    <!-- ..................... -->
    <complexType name="EventPropertyType">
```

```
            <sequence minOccurs="0">
                <element ref="om:Event"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
</schema>
```

2.3 procedure.xsd

This document implements the basic Procedure classes described in ANNEX C clause 4.2, and shown in the upper part of Figure 11.

Listing 2. procedure.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:swe="http://www.opengis.net/swe"
        xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
        xmlns:xlink="http://www.w3.org/1999/xlink" targetNamespace="http://www.opengeospatial.net/om/0.0"
        elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
        <annotation>
            <documentation>procedures.xsd

Components to describe procedures used in observations and measurements, and other events.

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ========================================================================== -->
        <!-- bring in other schemas -->
        <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
        <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
        <include schemaLocation="./event.xsd"/>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <!-- === Generic Procedure type === -->
        <complexType name="ProcedureSystemType">
            <annotation>
                <documentation>Generic re-usable procedure.
                Head of substitution group for specialized procedures, including instruments, sensors, algorithms and
simulaors.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:DefinitionType">
                    <sequence>
                        <element name="instanceIdentifier" type="swe:ScopedNameType" minOccurs="0">
                            <annotation>
                                <documentation>Identifier or serial number of specific instance of system.
                                If not present, then the system is a description of a generic re-usable procedure
type.</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ProcedureSystem" type="om:ProcedureSystemType" abstract="true"
substitutionGroup="gml:Definition">
            <annotation>
                <documentation>Generic re-usable procedure.
                Head of substitution group for specialized procedures, including instruments, sensors, algorithms and
simulaors.
```

```
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProcedureSystemPropertyType">
            <sequence minOccurs="0">
                <element ref="om:ProcedureSystem"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="ProcedureSequenceType">
            <annotation>
                <documentation>Specialized procedure defined as an ordered sequence of steps.
                Each step may be a procedure system (i.e. re-usable procedure) or procedure-event (i.e. specific use of
a procedure, with event-specific parameters).</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ProcedureSystemType">
                    <sequence>
                        <element name="step" type="om:ProcedurePropertyType" maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ProcedureSequence" type="om:ProcedureSequenceType"
substitutionGroup="om:ProcedureSystem">
            <annotation>
                <documentation>Specialized procedure defined as an ordered sequence of steps.
                Each step may be a procedure system (i.e. re-usable procedure) or procedure-event (i.e. specific use of
a procedure, with event-specific parameters).</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProcedureSequencePropertyType">
            <sequence minOccurs="0">
                <element ref="om:ProcedureSequence"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="ProcedurePackageType">
            <annotation>
                <documentation>Specialized procedure defined as a set of elements which operate concurrently or in
parallel.
                Each element may be a procedure system (i.e. re-usable procedure) or procedure-event (i.e. specific use
of a procedure, with event-specific parameters).</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ProcedureSystemType">
                    <sequence>
                        <element name="element" type="om:ProcedurePropertyType" maxOccurs="unbounded"/>
                    </sequence>
                    <attribute name="elementCount" type="positiveInteger"/>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ProcedurePackage" type="om:ProcedurePackageType"
substitutionGroup="om:ProcedureSystem">
            <annotation>
                <documentation>Specialized procedure defined as a set of elements which operate concurrently or in
parallel.
                Each element may be a procedure system (i.e. re-usable procedure) or procedure-event (i.e. specific use
of a procedure, with event-specific parameters).</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProcedurePackagePropertyType">
```

```
            <sequence minOccurs="0">
                <element ref="om:ProcedurePackage"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <complexType name="ProcedureEventType">
            <annotation>
                <documentation>Description of an event involving a procedure. Map binding a re-usable procedure
(procedure system) to a time and event-specific parameters.</documentation>
            </annotation>
            <complexContent>
                <extension base="om:EventType">
                    <sequence>
                        <element name="procedure" type="om:ProcedureSystemPropertyType"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ProcedureEvent" type="om:ProcedureEventType" substitutionGroup="om:Event">
            <annotation>
                <documentation>Description of an event involving a procedure. Map binding a re-usable procedure
(procedure system) to a time and event-specific parameters.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProcedureEventPropertyType">
            <sequence minOccurs="0">
                <element ref="om:ProcedureEvent"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="ProcedureHistoryType">
            <annotation>
                <documentation>An ordered sequence of ProcedureEvents.</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ProcedureEventType">
                    <sequence>
                        <element name="step" type="om:ProcedureEventPropertyType" maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ProcedureHistory" type="om:ProcedureHistoryType" substitutionGroup="om:ProcedureEvent">
            <annotation>
                <documentation>An ordered sequence of ProcedureEvents.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProcedureHistoryPropertyType">
            <sequence minOccurs="0">
                <element ref="om:ProcedureHistory"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="ProcedurePropertyType">
            <annotation>
                <documentation>Convenience property type to support selection of either a procedure system or
procedure event.</documentation>
            </annotation>
            <sequence minOccurs="0">
                <choice>
                    <element ref="om:ProcedureSystem"/>
                    <element ref="om:ProcedureEvent"/>
```

```
            </choice>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup"/>
        <attribute name="unionSemantics">
            <simpleType>
                <restriction base="string">
                    <enumeration value="procedureType"/>
                    <enumeration value="procedureUse"/>
                </restriction>
            </simpleType>
        </attribute>
    </complexType>
    <!-- ========================================================================== -->
</schema>
```

2.4 procedureSpecializations.xsd

This document implements the specialized Procedure classes described in ANNEX C clause 4.2, and shown in the lower part of Figure 11.

Listing 3. procedureSpecializations.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns="http://www.w3.org/2001/XMLSchema"
    xmlns:gml="http://www.opengis.net/gml" xmlns:gmd="http://www.isotc211.org/2005/gmd"
    xmlns:xlink="http://www.w3.org/1999/xlink" targetNamespace="http://www.opengeospatial.net/om/0.0"
    elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
    <annotation>
        <documentation>procedureSpecializations.xsd

Components to describe procedures used in observations and measurements, and other events.

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
    </annotation>
    <!-- ========================================================================== -->
    <!-- bring in other schemas -->
    <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
    <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
    <include schemaLocation="./procedure.xsd"/>
    <!-- ========================================================================== -->
    <!-- ========================================================================== -->
    <!-- === Specialised Procedure types === -->
    <!-- ========================================================================== -->
    <complexType name="ObservationProcedureType">
        <annotation>
            <documentation>Head of substitution group of observation procedures.
            Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
        </annotation>
        <complexContent>
            <extension base="om:ProcedureSystemType">
                <sequence>
                    <element name="method" type="gml:CodeType">
                        <annotation>
                            <documentation>Code for the particular procedure type.  Usually an item from a
list or registry of procedures, methods, instrument-types, etc.</documentation>
                        </annotation>
                    </element>
                    <element name="resultQuality" type="gmd:DQ_DataQuality_PropertyType" minOccurs="0">
                        <annotation>
                            <documentation>Quality associated systematically with observations made using
this procedure.</documentation>
                        </annotation>
                    </element>
                </sequence>
            </extension>
```

```
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ObservationProcedure" type="om:ObservationProcedureType"
substitutionGroup="om:ProcedureSystem">
            <annotation>
                <documentation>Head of substitution group of observation procedures.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ObservationProcedurePropertyType">
            <sequence minOccurs="0">
                <element ref="om:ObservationProcedure"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <complexType name="InstrumentType">
            <annotation>
                <documentation>Specialised observation procedure corresponding to a physical instrument or sensor.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ObservationProcedureType"/>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Instrument" type="om:InstrumentType" substitutionGroup="om:ObservationProcedure">
            <annotation>
                <documentation>Specialised observation procedure corresponding to a physical instrument or sensor.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="InstrumentPropertyType">
            <sequence minOccurs="0">
                <element ref="om:Instrument"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="CalculationProcedureType">
            <annotation>
                <documentation>Specialised observation procedure corresponding to an algorithm or computational
procedure.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ProcedureSystemType"/>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="CalculationProcedure" type="om:CalculationProcedureType"
substitutionGroup="om:ProcedureSystem">
            <annotation>
                <documentation>Specialised observation procedure corresponding to an algorithm or computational
procedure.
                Use gml:description element to describe the procedure or link to a definitive
description.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="CalculationProcedurePropertyType">
            <sequence minOccurs="0">
                <element ref="om:CalculationProcedure"/>
```

```
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================== -->
</schema>
```

2.5 observation.xsd

This document implements the basic Observation and ObservationCollection classes described in sub-clause 6.3 and sub-clause 6.8, and shown in Figure 1 and Figure 5.

In this XML implementation a global **AbstractObservation** element acts as the head of the Observation substitution group. AbstractObservation has no result property, so the concrete elements derived from AbstractObservation add a result of a suitable type. This mechanism avoids use of the XML Schema “restriction” mechanism to implement overriding the type of the result property. However, it means that the concrete Observation element, whose result has type=”xs:anyType”, is a sibling to the other specialized observation types, rather than parent. In an application schema, the om:AbstractObservationPropertyType should be used where the most general reference to an Observation is required.

Listing 4. observation.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
        xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:swe="http://www.opengis.net/swe"
        targetNamespace="http://www.opengeospatial.net/om/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified"
        version="pre-release">
         <annotation>
                <documentation>observation.xsd

An implementation of the OandM model for SWE

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ============================================================== -->
        <!-- bring in other schemas -->
        <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
        <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
        <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
        <include schemaLocation="./procedure.xsd"/>
        <!-- ============================================================== -->
        <!-- ============================================================== -->
        <!-- ===== Object types for Observations ====== -->
        <!-- ============================================================== -->
        <complexType name="AbstractObservationType">
                <annotation>
                        <documentation>Base type for Observations.

                        Observation is a specialized event, with a mandatory result.
                        The observed property may be any property associated with the type of the feature of interest.

                           Because of the well-known inconsistency in the implementation of XML Schema "restriction"
derivation,
                              this type is provided as a parent for all concrete observation types.
                              Concrete Observation types must extend this with a "result" of the appropriate type.

                           The following properties are inherited from EventType:
                              <!--   from AbstractGMLType
```

```
                        <element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
                        <element ref="gml:description" minOccurs="0"/>
                        <element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/> -->
                        <!--    from AbstractFeatureType
                        <element ref="gml:boundedBy" minOccurs="0"/> -->
                        <!--    from EventType
                        <element name="eventParameter" type="swe:TypedValuePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                        <element name="time" type="om:TimeObjectPropertyType" nillable="true"/>
                        <element name="precedingEvent" type="gml:StringOrRefType" minOccurs="0"
maxOccurs="unbounded"/>
                        <element name="followingEvent" type="gml:StringOrRefType" minOccurs="0"
maxOccurs="unbounded"/> -->

                        In the context of an Observation, the interpretation of some of the properties shall be refined as
follows:
                        time - the date/Time at which the procedure was executed</documentation>
                </annotation>
                <complexContent>
                        <extension base="om:EventType">
                                <sequence>
                                        <element name="responsible" type="gmd:CI_ResponsibleParty_PropertyType"
minOccurs="0">
                                                <annotation>
                                                        <documentation>Person or organisation responsible for the event, if applicable.
                                        The nature of the responsibility (i.e. the role of the party with respect to the event) may be
indicated using the xlink:arcrole attribute.
                                        Examples of roles are operator, sponsor, requestor, provider, processor,
etc.</documentation>
                                                </annotation>
                                        </element>
                                        <element name="quality" type="gmd:DQ_Element_PropertyType" minOccurs="0"
maxOccurs="unbounded">
                                                <annotation>
                                                        <documentation>Instance-specific quality assessment or measure.
                                                        Allow multiple quality measures if required.</documentation>
                                                </annotation>
                                        </element>
                                        <element name="procedure" type="om:ProcedurePropertyType">
                                                <annotation>
                                                        <documentation>Link to a description of the procedure or process used to
determine the result.
                                        This may be
                                        - a generic procedure or procedure type in which case all event-specific parameters are
associated with the observation event, or
                                        - a procedure instance with event specific parameters bound to the
procedure.</documentation>
                                                </annotation>
                                        </element>
                                        <element name="observedProperty" type="swe:PhenomenonPropertyType">
                                                <annotation>
                                                        <documentation>Link to a description of the property or phenomenon whose
value is being described or estimated through observation
                                                        for example "wavelength", "grass-species", "power", "intensity in the waveband x-
y", etc.
                                                        It is this feature-property that provides the (semantic) type of the observation.
                                                        Note that the description of the phenomenon may be quite specific and
constrained.
                                                        In general the precise details of the constraints describing the observe properties
require attention to the procedure used in making the observation:
                                                        e.g. an optical sensor typically has a wavelength-dependent response.
                                                        This property may be provided for client convenience, to allow comparison
between and aggregation of observations of the same property made using different procedures.</documentation>
                                                </annotation>
                                        </element>
                                        <element name="featureOfInterest" type="gml:FeaturePropertyType">
                                                <annotation>
                                                        <documentation>the Feature regarding which the observations are being made,
                                                        sometimes called the target or subject of the observation, such as a specimen,
station, tract, mountain, pixel, etc.
```

```
                                        The spatial properties (location) of this feature of interest are typically of most
interest for spatial analysis of the observation result.</documentation>
                                    </annotation>
                                </element>

                                <!--
                                <element name="result" type="anyType">
                                    <annotation>
                                        <documentation>This is a placeholder - concrete types must replace (restrict) this
with a "result" property of the correct type. </documentation>
                                    </annotation>
                                </element>
                                -->
                            </sequence>
                        </extension>
                    </complexContent>
                </complexType>
                <!-- ..................... -->
                <element name="AbstractObservation" type="om:AbstractObservationType" abstract="true"
substitutionGroup="om:Event">
                    <annotation>
                        <documentation>Head of Observation substitution group.              Base type for Observations.

                        Observation is a specialized event, with a mandatory result.
                        The observed property may be any property associated with the type of the feature of interest.

                          Because of the well-known inconsistency in the implementation of XML Schema "restriction"
derivation,
                            this type is provided as a parent for all concrete observation types.
                            Concrete Observation types must extend this with a "result" of the appropriate
type.</documentation>
                    </annotation>
                </element>
                <!-- ..................... -->
                <complexType name="AbstractObservationPropertyType">
                    <sequence minOccurs="0">
                        <element ref="om:AbstractObservation"/>
                    </sequence>
                    <attributeGroup ref="gml:AssociationAttributeGroup"/>
                </complexType>
                <!-- ================================================================== -->
                <complexType name="ObservationType">
                    <annotation>
                        <documentation>Generic Observation event.
                        carries a generic  "result" properties of type "anyType".
                        Because of the well-known inconsistency in the implementation of XML Schema "restriction" derivation,
                        in the XML Schema implementation the generic Observation is a sibling, rather than a parent, to the
specialized observations.</documentation>
                    </annotation>
                    <complexContent>
                        <extension base="om:AbstractObservationType">
                            <sequence>
                                <element name="resultDefinition" type="swe:RecordTypePropertyType" minOccurs="0"/>
                                <element name="result" type="anyType" nillable="true">
                                    <annotation>
                                        <documentation>an xsi:type attribute may appear in the instance to indicate the
type of the result</documentation>
                                    </annotation>
                                </element>
                            </sequence>
                        </extension>
                    </complexContent>
                </complexType>
                <!-- ..................... -->
                <element name="Observation" type="om:ObservationType" substitutionGroup="om:AbstractObservation">
                    <annotation>
                        <documentation>Generic Observation event</documentation>
                    </annotation>
                </element>
                <!-- ================================================================== -->
                <!-- ===== Observation Collection ======= -->
```

```
	<!-- ================================================================== -->
	<complexType name="ObservationCollectionType">
		<annotation>
			<documentation>Collection of arbitrary observations</documentation>
		</annotation>
		<complexContent>
			<extension base="om:EventType">
				<sequence>
					<element name="member" type="om:AbstractObservationPropertyType"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="ObservationCollection" type="om:ObservationCollectionType" substitutionGroup="om:Event">
		<annotation>
			<documentation>Collection of arbitrary observations</documentation>
		</annotation>
	</element>
	<!-- ================================================================== -->
</schema>
```

2.6 observationSpecializations.xsd

This document implements the specialized Observation classes described in sub-clause 6.5, and shown in Figure 2 and Figure 4.

Note that two versions of the discrete coverage observations are provided:

– DiscreteCoverageObservation, PointCoverageObservation, TimeSeriesObservation and ElementCoverageObservation implement the classes from Figure 4 using coverage types that implement the classes shown in Figure 3 explicitly

– in DiscreteCoverageObs, PointCoverageObs and TimeSeriesObs the domain objects in the coverage result are restricted to spatio-temporal point geometry, which leads to a more compact encoding.

Listing 5. observationSpecializations.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
	xmlns="http://www.w3.org/2001/XMLSchema" xmlns:om="http://www.opengeospatial.net/om/0.0"
	xmlns:swe="http://www.opengis.net/swe" targetNamespace="http://www.opengeospatial.net/om/0.0"
	elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
	 <annotation>
		<documentation>observationSpecializations.xsd

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This document contains various specializations of the basic observation pattern, primarily by fixing the type of the result.

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	</annotation>
	<!-- ================================================================== -->
	<!-- bring in other schemas -->
	<import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
	<import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
	<include schemaLocation="./observation.xsd"/>
	<!-- ================================================================== -->
	<!-- ================================================================== -->
	<!-- ===== Scalar Observations ====== -->
```

```
	<!-- ========================================================================== -->
	<complexType name="MeasurementType">
		<annotation>
			<documentation>Specialized Observation in which the result is a QualifiedMeasure</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="result" type="swe:QualifiedMeasureType" nillable="true">
						<annotation>
							<documentation>QualifiedMeasure adds a "qualifier" attribute to the standard
Measure type.
The qualifier allows some general uncertainty or limits to be expressed.</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="Measurement" type="om:MeasurementType" substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation in which the result is a QualifiedMeasure</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<complexType name="CategoryObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is a textual value from a controlled
vocabulary</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="result" type="swe:ScopedNameType">
						<annotation>
							<documentation>A Scoped Name is a term with a mandatory codeSpace
attribute</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="CategoryObservation" type="om:CategoryObservationType"
substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is a textual value from a controlled
vocabulary</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<complexType name="CountObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is an integer representing the count of the
observed property</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="result" type="integer">
						<annotation>
							<documentation>count of the observed property</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
```

```
	<element name="CountObservation" type="om:CountObservationType"
substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is an integer representing the count of the
observed property</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<complexType name="TruthObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is a boolean value representing the truth
value (e.g. existence) of the observed property</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="result" type="boolean">
						<annotation>
							<documentation>truth value (e.g. existence) of the observed
property</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="TruthObservation" type="om:TruthObservationType"
substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is a boolean value representing the truth
value (usually existence) of the observed property</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<!-- ===== Observation with constant complex result ====== -->
	<!-- ========================================================================== -->
	<complexType name="ComplexObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is a record representing a description of a
multi-component phenomenon.</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="resultDefinition" type="swe:RecordTypePropertyType">
						<annotation>
							<documentation>resultDefinition property contains or points to a record
schema,which describes the structure of the result value</documentation>
						</annotation>
					</element>
					<element name="result" type="swe:RecordPropertyType">
						<annotation>
							<documentation>result is a Record - i.e. a heterogeneous list of fields (ISO/IEC
11404) - describing a multi-component phenomenon</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="ComplexObservation" type="om:ComplexObservationType"
substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is a record representing a multi-component
phenomenon</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<!-- ===== Coverage Observations = sampling a phenomenon that varies on the feature of interest ====== -->
```

```
	<!-- ========================================================================== -->
	<!-- ========================================================================== -->
	<complexType name="DiscreteCoverageObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is a generalized discrete
coverage</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="resultDefinition" type="swe:RecordTypePropertyType">
						<annotation>
							<documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
						</annotation>
					</element>
					<element name="result" type="swe:CV_DiscreteCoveragePropertyType">
						<annotation>
							<documentation>generalized discrete coverage which describes the distribution of
a property on the feature of interest</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="DiscreteCoverageObservation" type="om:DiscreteCoverageObservationType"
		substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is a generalized discrete
coverage</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<complexType name="PointCoverageObservationType">
		<annotation>
			<documentation>Specialized Observation, in which the result is a point coverage which samples a
property at points in the feature of interest</documentation>
		</annotation>
		<complexContent>
			<extension base="om:AbstractObservationType">
				<sequence>
					<element name="resultDefinition" type="swe:RecordTypePropertyType">
						<annotation>
							<documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
						</annotation>
					</element>
					<element name="result" type="swe:CV_DiscretePointCoveragePropertyType">
						<annotation>
							<documentation>point coverage which samples a property at points in the feature
of interest</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..................... -->
	<element name="PointCoverageObservation" type="om:PointCoverageObservationType"
substitutionGroup="om:AbstractObservation">
		<annotation>
			<documentation>Specialized Observation, in which the result is a point coverage which samples a
property at points in the feature of interest</documentation>
		</annotation>
	</element>
	<!-- ========================================================================== -->
	<complexType name="TimeSeriesObservationType">
		<annotation>
```

```
                <documentation>Specialized Observation, in which the result is a time-instant coverage which samples a
property of the feature of interest at different times</documentation>
            </annotation>
            <complexContent>
                <extension base="om:AbstractObservationType">
                    <sequence>
                        <element name="resultDefinition" type="swe:RecordTypePropertyType">
                            <annotation>
                                <documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
                            </annotation>
                        </element>
                        <element name="result" type="swe:CV_DiscreteTimeInstantCoveragePropertyType">
                            <annotation>
                                <documentation>time-instant coverage which samples a property of the feature of
interest at different times</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="TimeSeriesObservation" type="om:TimeSeriesObservationType"
substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Specialized Observation, in which the result is a time-instant coverage which samples a
property of the feature of interest at different times</documentation>
            </annotation>
        </element>
        <!-- ================================================================== -->
        <complexType name="ElementCoverageObservationType">
            <annotation>
                <documentation>Specialized Observation, in which the result is a coverage whose domain elements
contain references to objects encoded elsewhere, which provide the sampling geometry of the feature of
interest</documentation>
            </annotation>
            <complexContent>
                <extension base="om:AbstractObservationType">
                    <sequence>
                        <element name="resultDefinition" type="swe:RecordTypePropertyType">
                            <annotation>
                                <documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
                            </annotation>
                        </element>
                        <element name="result" type="swe:CV_DiscreteElementCoveragePropertyType">
                            <annotation>
                                <documentation>coverage whose domain elements contain references to objects
encoded elsewhere, which provide the sampling geometry of the feature of interes</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="ElementCoverageObservation" type="om:ElementCoverageObservationType"
            substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Specialized Observation, in which the result is a coverage whose domain elements
contain references to objects encoded elsewhere, which provide the sampling geometry of the feature of
interest</documentation>
            </annotation>
        </element>
        <!-- ================================================================== -->
        <!-- === Compact coverage observations = implement the "geometry" element in the result in compact form === -->
        <!-- ================================================================== -->
        <complexType name="DiscreteCoverageObsType">
            <annotation>
```

```
                <documentation>Specialized Observation, in which the result is a compact representation of a
generalized discrete coverage</documentation>
            </annotation>
            <complexContent>
                <extension base="om:AbstractObservationType">
                    <sequence>
                        <element name="resultDefinition" type="swe:RecordTypePropertyType">
                            <annotation>
                                <documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
                            </annotation>
                        </element>
                        <element name="result" type="swe:CompactDiscreteCoveragePropertyType">
                            <annotation>
                                <documentation>compact representation of a generalized discrete coverage
which describes the distribution of a property on the feature of interest</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="DiscreteCoverageObs" type="om:DiscreteCoverageObsType"
substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Specialized Observation, in which the result is a compact representation of a
generalized discrete coverage</documentation>
            </annotation>
        </element>
        <!-- ====================================================================== -->
        <complexType name="PointCoverageObsType">
            <annotation>
                <documentation>Specialized Observation, in which the result is a compact representation of a point
coverage which samples a property at points in the feature of interest</documentation>
            </annotation>
            <complexContent>
                <extension base="om:AbstractObservationType">
                    <sequence>
                        <element name="resultDefinition" type="swe:RecordTypePropertyType">
                            <annotation>
                                <documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
                            </annotation>
                        </element>
                        <element name="result" type="swe:CompactDiscretePointCoveragePropertyType">
                            <annotation>
                                <documentation>compact representation of a point coverage which samples a
property at points in the feature of interest</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="PointCoverageObs" type="om:PointCoverageObsType"
substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Observation event</documentation>
            </annotation>
        </element>
        <!-- ====================================================================== -->
        <complexType name="TimeSeriesObsType">
            <annotation>
                <documentation>Specialized Observation, in which the result is a compact representation of a time-
instant coverage which samples a property of the feature of interest at different times</documentation>
            </annotation>
            <complexContent>
                <extension base="om:AbstractObservationType">
                    <sequence>
```

```
                        <element name="resultDefinition" type="swe:RecordTypePropertyType">
                            <annotation>
                                <documentation>resultDefinition property contains or points to a record schema,
which describes the structure of the value element in each geometry-value pair</documentation>
                            </annotation>
                        </element>
                        <element name="result" type="swe:CompactDiscreteTimeCoveragePropertyType">
                            <annotation>
                                <documentation>compact representation of a time-instant coverage which
samples a property of the feature of interest at different times</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="TimeSeriesObs" type="om:TimeSeriesObsType" substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Specialized Observation, in which the result is a compact representation of a time-
instant coverage which samples a property of the feature of interest at different times</documentation>
            </annotation>
        </element>
        <!-- ========================================================================= -->
</schema>
```

2.7 commonObservation.xsd

This document implements a specialized Observation class called "CommonObservation", which restricts the result to the AnyData encodings developed for the SensorML specification. This allows a variety of common result types to be encoded in a compact form, including lists of records and time-series. It uses specialized record schema definition instead of an XML Schema definition of the result structure.

Listing 6. commonObservation.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.opengeospatial.net/om/0.0" xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
    <annotation>
        <documentation>commObservation.xsd

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This document contains commonObservation, which fixes the type of the result.

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    </annotation>
    <!-- ========================================================================= -->
    <!-- bring in other schemas -->
    <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
    <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
    <include schemaLocation="./observation.xsd"/>
    <!-- ========================================================================= -->
    <!-- ========================================================================= -->
    <!-- === Compact coverage observations = implement the result in compact form as microformatted list (not XML-
encoded) === -->
    <!-- ========================================================================= -->
    <complexType name="CommonObservationType">
        <annotation>
            <documentation>Observation event.   </documentation>
        </annotation>
        <complexContent>
```

```
                <extension base="om:AbstractObservationType">
                    <sequence>
                        <element name="result" nillable="true">
                            <complexType>
                                <sequence>
                                    <group ref="swe:AnyData"/>
                                </sequence>
                            </complexType>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="CommonObservation" type="om:CommonObservationType"
substitutionGroup="om:AbstractObservation">
            <annotation>
                <documentation>Observation event</documentation>
            </annotation>
        </element>
        <!-- ================================================================== -->
</schema>
```

2.8 om.xsd

This stub schema document collects all Observations and Measurements components. Use of this document in for external references to the O&M package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 7. om.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:om="http://www.opengeospatial.net/om/0.0"
targetNamespace="http://www.opengeospatial.net/om/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
        <annotation>
            <documentation>om.xsd

The complete Observations and Measurements schema

Copyright © 2005 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ================================================================== -->
        <include schemaLocation="./observationSpecializations.xsd"/>
        <include schemaLocation="./procedureSpecializations.xsd"/>
        <include schemaLocation="./commonObservation.xsd"/>
        <!-- ================================================================== -->
</schema>
```

3 Sampling features schema

3.1 Namespace

The Sampling Features schema is in the namespace http://www.opengeospatial.net/sampling/0.0

3.2 samplingBase.xsd

This document implements the basic SamplingFeature and SamplingFeatureRelation classes described in sub-clause 7.2 and shown in Figure 6, together with Station described in sub-clause 7.3 and shown in Figure 7.

Listing 8. samplingBase.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:gml="http://www.opengis.net/gml" xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:swe="http://www.opengis.net/swe" xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:sa="http://www.opengeospatial.net/sampling/0.0"
      targetNamespace="http://www.opengeospatial.net/sampling/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
      <annotation>
            <documentation>samplingBase.xsd

Sampling features are feature types that are used primarily for making observations:
Station (0-D), SamplingFeature, and collections are described in this schema document

Profile, Interval, Traverse, Flightline, Borehole (1-D)
SurfaceOfInterest, Swath (2-D)
SolidOfInterest (3-D) are described in extensiveSite.xsd

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
      </annotation>
      <!-- ============================================================================ -->
      <!-- bring in other schemas -->
      <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
      <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
      <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
      <import namespace="http://www.opengeospatial.net/om/0.0" schemaLocation="../../om/current/om.xsd"/>
      <!--
      <include schemaLocation="../enumerations/LUTgeography.xsd"/>
      -->
      <!-- ============================================================================ -->
      <!-- ===== Feature types in Site hierarchy ====== -->
      <!-- ============================================================================ -->
      <complexType name="SamplingFeatureType">
            <annotation>
                  <documentation>A "SamplingFeature" is a feature used primarily for taking
observations.</documentation>
            </annotation>
            <complexContent>
                  <extension base="gml:AbstractFeatureType">
                        <sequence>
                              <element name="property" type="swe:TypedValuePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                              <element name="responsible" type="gmd:CI_ResponsibleParty_PropertyType"
minOccurs="0"/>
                              <element name="relatedObservation" type="om:AbstractObservationPropertyType"
minOccurs="0" maxOccurs="unbounded"/>
                              <element name="relatedSamplingFeature" type="sa:SamplingFeatureRelationPropertyType"
minOccurs="0" maxOccurs="unbounded">
                                    <annotation>
                                          <documentation>A samplingFeature is often associated with a set of member
samplingFeatures: e.g. stations on a traverse, intervals in a borehole or section, boreholes within an area of
interest.</documentation>
                                    </annotation>
                              </element>
                              <element name="sampledFeature" type="gml:FeaturePropertyType" minOccurs="0">
                                    <annotation>
                                          <documentation>Pointer to the domain feature being sampled, if
available</documentation>
                                    </annotation>
                              </element>
                              <element name="surveyDetails" type="om:ProcedurePropertyType" minOccurs="0">
                                    <annotation>
                                          <documentation>Description of, or link to, the procedure used in determining the
position of the samplingFeature.
            For complex procedures, such as when elevation and position are determined separately, may be
disaggregated.</documentation>
                                    </annotation>
                              </element>
                        </sequence>
                  </extension>
```

```
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="SamplingFeature" type="sa:SamplingFeatureType" substitutionGroup="gml:AbstractFeature"/>
        <!-- ..................... -->
        <complexType name="SamplingFeaturePropertyType">
            <sequence minOccurs="0">
                <element ref="sa:SamplingFeature"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
        <complexType name="SamplingFeatureRelationType">
            <annotation>
                <documentation>A "SamplingFeatureRelation" is used to describe relationships between sampling
features, including part-whole, siblings, etc.</documentation>
            </annotation>
            <sequence>
                <element name="role" type="gml:CodeType"/>
                <element name="target" type="sa:SamplingFeaturePropertyType"/>
            </sequence>
        </complexType>
        <!-- ..................... -->
        <element name="SamplingFeatureRelation" type="sa:SamplingFeatureRelationType"/>
        <!-- ..................... -->
        <complexType name="SamplingFeatureRelationPropertyType">
            <sequence>
                <element ref="sa:SamplingFeatureRelation"/>
            </sequence>
        </complexType>
        <!-- ============================================================================ -->
        <!-- ============================================================================ -->
        <!-- 0-D sites and sampling regimes -->
        <!-- ============================================================================ -->
        <complexType name="StationType">
            <annotation>
                <documentation>A "Station" is an identified position (0-D geospatial feature).
            It may be revisited for various purposes, in particular to retrieve multiple specimens or make repeated or
complementary observations.
            The position property of the station provides the value of the position property of observations an specimens
associated with the station.
            By using the Station feature, this position information and any metadata associated with it may be encoded in
one place, i.e. normalised, and then re-used _by reference_ on other feature instances associated with
it.</documentation>
            </annotation>
            <complexContent>
                <extension base="sa:SamplingFeatureType">
                    <sequence>
                        <element name="position" type="gml:PointPropertyType"/>
                        <element name="elevation" type="gml:DirectPositionType" minOccurs="0">
                            <annotation>
                                <documentation>Use the srsName attribute to record the elevation
datum</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Station" type="sa:StationType" substitutionGroup="sa:SamplingFeature"/>
        <!-- ..................... -->
        <complexType name="StationPropertyType">
            <sequence minOccurs="0">
                <element ref="sa:Station"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
</schema>
```

3.3 extensiveSampling.xsd

This document implements the specialized SamplingFeature classes described in sub-clause 7.3 and shown in Figure 7.

Listing 9. extensiveSampling.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:gml="http://www.opengis.net/gml" xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
      xmlns:swe="http://www.opengis.net/swe" xmlns:om="http://www.opengeospatial.net/om/0.0"
      xmlns="http://www.w3.org/2001/XMLSchema" xmlns:sa="http://www.opengeospatial.net/sampling/0.0"
      targetNamespace="http://www.opengeospatial.net/sampling/0.0" elementFormDefault="qualified"
      attributeFormDefault="unqualified" version="pre-release">
       <annotation>
            <documentation>extensiveSite.xsd

SamplingFeatures are feature types that are used primarily for making observations:
SamplingFeature, Station and collections are described in samplingBase.xsd

Profile (1-D)
SurfaceOfInterest (2-D)
SolidOfInterest (3-D) are described in this schema document

In many cases the properties of interest vary within the site, so may be represented as a coverage associated with the
SamplingFeature.

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
      </annotation>
      <!-- ============================================================== -->
      <!-- bring in other schemas -->
      <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
      <import namespace="http://www.opengeospatial.net/om/0.0" schemaLocation="../../om/current/om.xsd"/>
      <import namespace="http://www.opengeospatial.net/geomExt/0.0"
schemaLocation="../../geo/current/geomExt.xsd"/>
      <import namespace="http://www.opengis.net/swe" schemaLocation="../../sweCommon/current/swe.xsd"/>
      <include schemaLocation="./samplingBase.xsd"/>
      <!-- ============================================================== -->
      <!-- 1-D sites and sampling regimes -->
      <!-- ============================================================== -->
      <complexType name="ProfileType">
            <annotation>
                  <documentation>A "Profile" is an identified 1-D spatial feature.
            It may be revisited for various purposes, in particular to retrieve multiple specimens or make repeated or
complementary observations.
            Specialized names for Profile include Sounding, ObservationWell, FlightLine, Transect.</documentation>
            </annotation>
            <complexContent>
                  <extension base="sa:SamplingFeatureType">
                        <sequence>
                              <element name="begin" type="gml:PointPropertyType"/>
                              <element name="end" type="gml:PointPropertyType"/>
                              <element name="length" type="gml:MeasureType" minOccurs="0"/>
                              <element name="propertyLog" type="swe:CV_DiscreteCoveragePropertyType"
minOccurs="0" maxOccurs="unbounded">
                                    <annotation>
                                          <documentation>In addition to the constant "property" inherited from the base
type, Profiles may also have properties that vary along their length.
                              These are encoded as discrete coverages.</documentation>
                                    </annotation>
                              </element>
                              <element name="shape" type="geox:Shape1DPropertyType"/>
                        </sequence>
                  </extension>
            </complexContent>
      </complexType>
      <!-- ..................... -->
      <element name="Profile" type="sa:ProfileType" substitutionGroup="sa:SamplingFeature">
            <annotation>
```

```
                <documentation>A "Profile" is an identified 1-D spatial feature.
            It may be revisited for various purposes, in particular to retrieve multiple specimens or make repeated or
complementary observations.
            Specialized names for Profile include Sounding, ObservationWell, FlightLine, Transect.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ProfilePropertyType">
            <sequence minOccurs="0">
                <element ref="sa:Profile"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
        <!-- 2-D sites and sampling regimes -->
        <!-- ============================================================================ -->
        <complexType name="SurfaceOfInterestType">
            <annotation>
                <documentation>A "SurfaceOfInterest" is an identified 2-D spatial feature.
            It may be used for various purposes, in particular for observations of cross sections through features.
            Specialized names for SurfaceOfInterest include CrossSection, Section, Flitch, Swath, Scene,
MapHorizon.</documentation>
            </annotation>
            <complexContent>
                <extension base="sa:SamplingFeatureType">
                    <sequence>
                        <element name="area" type="gml:MeasureType" minOccurs="0"/>
                        <element name="propertyMap" type="swe:CV_DiscreteCoveragePropertyType"
minOccurs="0" maxOccurs="unbounded">
                            <annotation>
                                <documentation>In addition to the constant "property" inherited from the base
type, Surfaces may also have properties that vary across their extent.
                                These are encoded as discrete coverages.</documentation>
                            </annotation>
                        </element>
                        <element name="shape" type="geox:Shape2DPropertyType"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="SurfaceOfInterest" type="sa:SurfaceOfInterestType" substitutionGroup="sa:SamplingFeature">
            <annotation>
                <documentation>A "SurfaceOfInterest" is an identified 2-D spatial feature.
            It may be used for various purposes, in particular for observations of cross sections through features.
            Specialized names for SurfaceOfInterest include CrossSection, Section, Flitch, Swath, Scene,
MapHorizon.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="SurfaceOfInterestPropertyType">
            <sequence minOccurs="0">
                <element ref="sa:SurfaceOfInterest"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
        <!-- 3-D sites and sampling regimes -->
        <!-- ============================================================================ -->
        <complexType name="SolidOfInterestType">
            <annotation>
                <documentation>A "SolidOfInterest" is an identified 3-D spatial feature used in
sampling.</documentation>
            </annotation>
            <complexContent>
                <extension base="sa:SamplingFeatureType">
                    <sequence>
                        <element name="volume" type="gml:MeasureType" minOccurs="0"/>
                        <element name="propertyFill" type="swe:CV_DiscreteCoveragePropertyType"
minOccurs="0" maxOccurs="unbounded">
                            <annotation>
```

```
                                        <documentation>In addition to the constant "property" inherited from the base
type, Solids may also have properties that vary within their extent.
                                These are encoded as discrete coverages.</documentation>
                                    </annotation>
                                </element>
                                <element name="shape" type="geox:Shape3DPropertyType"/>
                            </sequence>
                        </extension>
                    </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="SolidOfInterest" type="sa:SolidOfInterestType" substitutionGroup="sa:SamplingFeature">
                <annotation>
                        <documentation>A "SolidOfInterest" is an identified 3-D spatial feature used in
sampling.</documentation>
                </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="SolidOfInterestPropertyType">
                <sequence minOccurs="0">
                        <element ref="sa:SolidOfInterest"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
        <!-- ============================================================================ -->
</schema>
```

3.4 specimen.xsd

This document implements the Specimen classes described in sub-clause 7.4 and shown in Figure 8.

Listing 10. specimen.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:gml="http://www.opengis.net/gml" xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:sa="http://www.opengeospatial.net/sampling/0.0" targetNamespace="http://www.opengeospatial.net/sampling/0.0"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
        <annotation>
                <documentation>specimen.xsd

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ============================================================================ -->
        <!-- bring in other schemas -->
        <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
        <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
        <import namespace="http://www.opengeospatial.net/om/0.0" schemaLocation="../../om/current/om.xsd"/>
        <include schemaLocation="./samplingBase.xsd"/>
        <!--
        <include schemaLocation="../enumerations/LUTgeography.xsd"/>
        -->
        <!-- ============================================================================ -->
        <!-- ============================================================================ -->
        <complexType name="SpecimenType">
                <annotation>
                        <documentation>A located object on which measurements may be made.

                        A "Station" from where the specimen was obtained may be recorded using the samplingStation property.

                        A basic material classification is provided using the "material" property.
```

```
                Its value may be relatively generic (rock, pulp) or may reflect a detailed classification (calcrete,
adamellite, biotite-schist).
                In the latter case it is wise to use the codeSpace attribute to provide a link to the classification
scheme/vocabulary used.

                Note that if this specimen is a "processed" version of another (e.g. by grinding, seiving, etc) then
                the predecessor (if known) may be recorded as a relatedFeature

                If this specimen has been processed from an "original" specimen,
                as collected in the field or as supplied to the lab,
                but results should be reported regarding the original,
                then the original may be indicated using the reportingSpecimen property.

                Related observations may also be recorded using the relatedFeature property.</documentation>
            </annotation>
            <complexContent>
                <extension base="sa:SamplingFeatureType">
                    <sequence>
                        <element name="currentLocation" type="sa:LocationPropertyType" minOccurs="0">
                            <annotation>
                                <documentation>Shelf location of specimen</documentation>
                            </annotation>
                        </element>
                        <element name="currentSize" type="gml:MeasureType" minOccurs="0">
                            <annotation>
                                <documentation>The size of the specimen</documentation>
                            </annotation>
                        </element>
                        <element name="materialClass" type="gml:CodeType">
                            <annotation>
                                <documentation>Material type, usually taken from a controlled vocabulary
                        Specialised domains may choose to fix the vocabulary to be used</documentation>
                            </annotation>
                        </element>
                        <element name="processingDetails" type="om:ProcedureEventPropertyType"
minOccurs="0">
                            <annotation>
                                <documentation>One or more procedures may have been applied to a specimen.
        May contain collection, sampling and preparation procedures</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Specimen" type="sa:SpecimenType" substitutionGroup="sa:SamplingFeature"/>
        <!-- ..................... -->
        <complexType name="SpecimenPropertyType">
            <sequence minOccurs="0">
                <element ref="sa:Specimen"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="LocatedSpecimenType">
            <annotation>
                <documentation/>
            </annotation>
            <complexContent>
                <extension base="sa:SpecimenType">
                    <sequence>
                        <element name="locationMethod" type="gml:CodeType" minOccurs="0"/>
                        <element name="samplingLocation" type="gml:GeometryPropertyType"/>
                        <element name="samplingMethod" type="om:ProcedureSystemPropertyType"
minOccurs="0"/>
                        <element name="samplingTime" type="gml:TimePrimitivePropertyType">
                            <annotation>
                                <documentation>Time and date when the specimen was initially
retrieved</documentation>
                            </annotation>
```

```
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="LocatedSpecimen" type="sa:LocatedSpecimenType" substitutionGroup="sa:Specimen"/>
        <!-- ..... -->
        <complexType name="LocatedSpecimenPropertyType">
            <sequence minOccurs="0">
                <element ref="sa:LocatedSpecimen"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================= -->
        <complexType name="LocationPropertyType">
            <sequence minOccurs="0">
                <choice>
                    <element ref="gml:AbstractGeometry"/>
                    <element ref="gmd:EX_GeographicDescription"/>
                </choice>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attribute name="unionSemantics">
                <simpleType>
                    <restriction base="string">
                        <enumeration value="geometryLocation"/>
                        <enumeration value="nameLocation"/>
                    </restriction>
                </simpleType>
            </attribute>
        </complexType>
        <!-- ========================================================================= -->
</schema>
```

3.5 surveyProcedure.xsd

This document implements the specialized Survey Procedure class described in sub-clause7.2, and shown in Figure 6.

Listing 11. surveyProcedure.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:sa="http://www.opengeospatial.net/sampling/0.0" xmlns="http://www.w3.org/2001/XMLSchema"
    xmlns:gml="http://www.opengis.net/gml" xmlns:gmd="http://www.isotc211.org/2005/gmd"
    xmlns:om="http://www.opengeospatial.net/om/0.0" targetNamespace="http://www.opengeospatial.net/sampling/0.0"
    elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
     <annotation>
        <documentation>surveyProcedure.xsd

Components to describe procedures used in sampling.

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
    </annotation>
    <!-- ========================================================================= -->
    <!-- bring in other schemas -->
    <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
    <import namespace="http://www.isotc211.org/2005/gmd"
schemaLocation="../../../../gml/trunk/gml/3.2.0/gmd/gmd.xsd"/>
    <import namespace="http://www.opengeospatial.net/om/0.0" schemaLocation="../../om/current/om.xsd"/>
    <include schemaLocation="./LUTgeodesy.xsd"/>
    <!-- ========================================================================= -->
    <!-- ========================================================================= -->
    <complexType name="SurveyProcedureType">
        <annotation>
```

```
                <documentation>Specialized procedure related to surveying positions and locations.</documentation>
            </annotation>
            <complexContent>
                <extension base="om:ObservationProcedureType">
                    <sequence>
                        <element name="positionMethod" type="sa:positionMethodType" minOccurs="0"/>
                        <element name="positionAccuracy" type="gml:MeasureType" minOccurs="0"/>
                        <element name="elevationMethod" type="sa:elevationMethodType" minOccurs="0"/>
                        <element name="elevationAccuracy" type="gml:MeasureType" minOccurs="0"/>
                        <element name="projection" type="sa:projections" minOccurs="0"/>
                        <element name="geodeticDatum" type="sa:gDatums" minOccurs="0"/>
                        <element name="elevationDatum" type="sa:vDatums" minOccurs="0"/>
                        <element name="operator" type="gmd:CI_ResponsibleParty_PropertyType" minOccurs="0">
                            <annotation>
                                <documentation>Note than in other contexts the "operator" is not embedded in
the procedure description. Maybe needs a tweak later?</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="SurveyProcedure" type="sa:SurveyProcedureType"
substitutionGroup="om:ObservationProcedure">
            <annotation>
                <documentation>Specialized procedure related to surveying positions and locations.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="SurveyProcedurePropertyType">
            <sequence minOccurs="0">
                <element ref="sa:SurveyProcedure"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
</schema>
```

3.6 sampling.xsd

This stub schema document collects all the Sampling Features components. Use of this document in for external references to the Sampling Features package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 12. Sampling.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:sa="http://www.opengeospatial.net/sampling/0.0"
targetNamespace="http://www.opengeospatial.net/sampling/0.0"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="pre-release">
        <annotation>
            <documentation>sampling.xsd

The complete sampling schema

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ========================================================================== -->
        <include schemaLocation="./surveyProcedure.xsd"/>
        <include schemaLocation="./extensiveSampling.xsd"/>
        <include schemaLocation="./specimen.xsd"/>
        <!-- ========================================================================== -->
</schema>
```

4 Additional Geometry Schemas

4.1 Namespace

A set of schemas describe some geometry components defined to augment the set provided by GML. These are provided as convenience geometries in the context of the Sampling Feature Schema (ANNEX D clause 3). These are in the namespace http://www.opengeospatial.net/geomExt/0.0 .

4.2 geometry.xsd

This document implements some compact encodings of and simple geometries, including LineByVector, PlaneByVector, MultiLineString, MuliPolygon, MultiInterval.

Listing 13. geometry.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
targetNamespace="http://www.opengeospatial.net/geomExt/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
    <annotation>
        <documentation>geometry.xsd

A GML conformant schema for specialised geometries

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
    </annotation>
    <!-- ================================================================== -->
    <!-- bring in other schemas -->
    <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
    <!-- ================================================================== -->
    <!-- ================================================================== -->
    <!-- === Compact form of multi-position.  === -->
    <!-- ========================================================= -->
    <complexType name="MultiPosType">
        <annotation>
            <documentation>A MultiPos is defined by a list of direct positions</documentation>
        </annotation>
        <complexContent>
            <extension base="gml:AbstractGeometricAggregateType">
                <sequence>
                    <choice>
                        <element name="pos" type="gml:DirectPositionType" maxOccurs="unbounded"/>
                        <element name="posList" type="gml:DirectPositionListType"/>
                    </choice>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <!-- ================================================================== -->
    <element name="MultiPos" type="geox:MultiPosType" substitutionGroup="gml:AbstractGeometricAggregate"/>
    <!-- ========================================================= -->
    <!-- ================================================================== -->
    <!-- === Geometric primitives === -->
    <!-- ================================================================== -->
    <!-- === Parameterised Lines === -->
    <!-- ================================================================== -->
    <!-- ================================================================== -->
    <complexType name="AbstractLineType" abstract="true">
        <annotation>
            <documentation>An abstraction of a line to support the different levels of complexity.
The line can always be viewed as a geometric primitive, i.e. is logically continuous.</documentation>
        </annotation>
```

```
            <complexContent>
                <extension base="gml:AbstractCurveType"/>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="AbstractLine" type="geox:AbstractLineType" abstract="true"
substitutionGroup="gml:AbstractCurve">
            <annotation>
                <documentation>The "AbstractLine" element is the abstract head of the substituition group for all
elements representing (infinite) Lines.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="LineByVectorType">
            <annotation>
                <documentation>Line carries an id, so can be used as the target of a reference. This is useful so that the
survey defines a 1-D CRS used for indexing information along the borehole.</documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractLineType">
                    <sequence>
                        <element name="origin" type="gml:PointPropertyType">
                            <annotation>
                                <documentation>Line is expressed as an origin and direction.</documentation>
                            </annotation>
                        </element>
                        <choice>
                            <element name="direction" type="gml:VectorType">
                                <annotation>
                                    <documentation>A simple direction relative to the origin.</documentation>
                                </annotation>
                            </element>
                            <element name="directionDescription" type="gml:CodeType"/>
                        </choice>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="LineByVector" type="geox:LineByVectorType" substitutionGroup="geox:AbstractLine"/>
        <element name="Line" type="geox:LineByVectorType" substitutionGroup="geox:AbstractLine"/>
        <!-- ========================================================================== -->
        <!-- === Parameterised Planes === -->
        <!-- ========================================================================== -->
        <complexType name="AbstractPlaneType" abstract="true">
            <annotation>
                <documentation>An abstraction of a plane to support the different levels of complexity.
    The plane can always be viewed as a geometric primitive, i.e. is logically continuous.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractSurfaceType"/>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="AbstractPlane" type="geox:AbstractPlaneType" abstract="true"
substitutionGroup="gml:AbstractSurface">
            <annotation>
                <documentation>The "AbstractPlane" element is the abstract head of the substituition group for all
elements representing (infinite) planes.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="PlaneByVectorType">
            <annotation>
                <documentation>Plane defined by its normal and a point contined within the plane.</documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractPlaneType">
                    <sequence>
                        <element name="containedPoint" type="gml:PointPropertyType"/>
                        <element name="normal" type="gml:VectorType"/>
```

```
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="PlaneByVector" type="geox:PlaneByVectorType" substitutionGroup="geox:AbstractPlane"/>
        <!-- ================================================================== -->
        <!-- === Some convenience geometry aggregates === -->
        <!-- ========================================================== -->
        <complexType name="LineStringPropertyType">
            <sequence minOccurs="0">
                <element ref="gml:LineString"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="MultiLineStringType">
            <annotation>
                <documentation>A MultiLineString is defined by one or more LineStrings, referenced through
lineStringMember elements. </documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricAggregateType">
                    <sequence minOccurs="0" maxOccurs="unbounded">
                        <element name="member" type="geox:LineStringPropertyType"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="MultiLineString" type="geox:MultiLineStringType"
substitutionGroup="gml:AbstractGeometricAggregate"/>
        <!-- ..... -->
        <complexType name="MultiLineStringPropertyType">
            <sequence minOccurs="0">
                <element ref="geox:MultiLineString"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <!-- ========================================================== -->
        <complexType name="PolygonPropertyType">
            <sequence minOccurs="0">
                <element ref="gml:Polygon"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="MultiPolygonType">
            <annotation>
                <documentation>A MultiPolygon is defined by one or more Polygons, referenced through
polygonMember elements. </documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricAggregateType">
                    <sequence minOccurs="0" maxOccurs="unbounded">
                        <element name="member" type="geox:PolygonPropertyType"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="MultiPolygon" type="geox:MultiPolygonType"
substitutionGroup="gml:AbstractGeometricAggregate"/>
        <!-- ..... -->
        <complexType name="MultiPolygonPropertyType">
            <sequence minOccurs="0">
                <element ref="geox:MultiPolygon"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
```

```
        <!-- ========================================================== -->
        <!-- === Convenience content-model group for nodes, recorded either as direct positions or Points === -->
        <!-- ========================================================== -->
        <group name="posProperty">
                <choice>
                        <element ref="gml:pos"/>
                        <element ref="gml:pointProperty"/>
                </choice>
        </group>
        <!-- ========================================================================== -->
        <!-- === Intervals === -->
        <!-- ========================================================== -->
        <complexType name="GIntervalType">
                <annotation>
                        <documentation>GInterval defines a simple curve segment using a pair of positions.</documentation>
                </annotation>
                <complexContent>
                        <extension base="gml:AbstractCurveType">
                                <sequence>
                                        <choice>
                                                <element name="beginPos" type="gml:DirectPositionType"/>
                                                <element name="begin" type="gml:PointPropertyType"/>
                                        </choice>
                                        <choice>
                                                <element name="endPos" type="gml:DirectPositionType"/>
                                                <element name="end" type="gml:PointPropertyType"/>
                                        </choice>
                                </sequence>
                        </extension>
                </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="GInterval" type="geox:GIntervalType" substitutionGroup="gml:AbstractCurve"/>
        <!-- ..... -->
        <complexType name="GIntervalPropertyType">
                <sequence minOccurs="0">
                        <element ref="geox:GInterval"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="MultiGIntervalType">
                <annotation>
                        <documentation>A MultiGInterval is defined by one or more GIntervals.</documentation>
                </annotation>
                <complexContent>
                        <extension base="gml:AbstractGeometricAggregateType">
                                <sequence>
                                        <element name="member" type="geox:GIntervalPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                                </sequence>
                        </extension>
                </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="MultiGInterval" type="geox:MultiGIntervalType"
substitutionGroup="gml:AbstractGeometricAggregate"/>
        <!-- ========================================================== -->
        <!-- ========================================================== -->
        <!-- === Support for geometric objects defined using their vertices only, implicit topology === -->
        <!-- ========================================================== -->
        <element name="exterior3Points">
                <complexType>
                        <sequence/>
                        <attribute name="v0" type="anyURI" use="required"/>
                        <attribute name="v1" type="anyURI" use="required"/>
                        <attribute name="v2" type="anyURI" use="required"/>
                </complexType>
        </element>
        <!-- ========================================================== -->
        <element name="exterior4Points">
```

```
            <complexType>
                <sequence/>
                <attribute name="v0" type="anyURI" use="required"/>
                <attribute name="v1" type="anyURI" use="required"/>
                <attribute name="v2" type="anyURI" use="required"/>
                <attribute name="v3" type="anyURI" use="required"/>
            </complexType>
        </element>
        <!-- ========================================================== -->
        <element name="exterior5Points">
            <complexType>
                <sequence/>
                <attribute name="v0" type="anyURI" use="required"/>
                <attribute name="v1" type="anyURI" use="required"/>
                <attribute name="v2" type="anyURI" use="required"/>
                <attribute name="v3" type="anyURI" use="required"/>
                <attribute name="v4" type="anyURI" use="required"/>
            </complexType>
        </element>
        <!-- ========================================================== -->
        <element name="exterior6Points">
            <complexType>
                <sequence/>
                <attribute name="v0" type="anyURI" use="required"/>
                <attribute name="v1" type="anyURI" use="required"/>
                <attribute name="v2" type="anyURI" use="required"/>
                <attribute name="v3" type="anyURI" use="required"/>
                <attribute name="v4" type="anyURI" use="required"/>
                <attribute name="v5" type="anyURI" use="required"/>
            </complexType>
        </element>
        <!-- ========================================================== -->
        <element name="exterior8Points">
            <complexType>
                <sequence/>
                <attribute name="v0" type="anyURI" use="required"/>
                <attribute name="v1" type="anyURI" use="required"/>
                <attribute name="v2" type="anyURI" use="required"/>
                <attribute name="v3" type="anyURI" use="required"/>
                <attribute name="v4" type="anyURI" use="required"/>
                <attribute name="v5" type="anyURI" use="required"/>
                <attribute name="v6" type="anyURI" use="required"/>
                <attribute name="v7" type="anyURI" use="required"/>
            </complexType>
        </element>
        <!-- ========================================================== -->
        <!-- ========================================================== -->
        <!-- === Convenience properties === -->
        <!-- ========================================================== -->
        <element name="nodes" type="gml:MultiPointPropertyType">
            <annotation>
                <documentation>A place to attach a set of nodes that are required to be listed someplace, in order that
they can be "used" by-reference elsewhere, for example to build a complex geometry that may be the "shape" of a
feature.  Since they are to be used "by-reference" they require handles - hence the use of gml:Point primitives rather than
the handle-less gml:pos and gml:posList.</documentation>
            </annotation>
        </element>
        <!-- ========================================================================== -->
</schema>
```

4.3 surfaces.xsd

This document implements a compact encoding for Triangulated Surfaces.

Listing 14. surfaces.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
targetNamespace="http://www.opengeospatial.net/geomExt/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified"
      version="pre-release">
       <annotation>
            <documentation>surfaces.xsd

A GML conformant schema for specialised geometries
Triangulated surfaces

Copyright (c) 2006 CSIRO - see
https://www.seegrid.csiro.au/twiki/bin/view/Xmml/LegalNotices#Software_Notice</documentation>
       </annotation>
       <!-- ============================================================================ -->
       <!-- bring in other schemas -->
       <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
       <include schemaLocation="./geometry.xsd"/>
       <!-- ============================================================================ -->
       <!-- ============================================================================ -->
       <!-- ============================================================================ -->
       <!-- === Compact triangulated surface encoding === -->
       <!-- ============================================================================ -->
       <complexType name="TriSurfaceType">
            <complexContent>
                 <extension base="gml:AbstractSurfaceType">
                      <sequence>
                           <element name="patch" type="geox:ThreeVertexSurfacePatchPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                      </sequence>
                 </extension>
            </complexContent>
       </complexType>
       <!-- ..................... -->
       <element name="TriSurface" type="geox:TriSurfaceType" substitutionGroup="gml:AbstractSurface">
            <annotation>
                 <documentation>More flexible, and potentially more compact version of a set of triangles, directly
derived by restricting the general composite provided by GML, allowing either gml:Triangle or geox:Triangle as
members</documentation>
            </annotation>
       </element>
       <!-- ============================================================================ -->
       <!-- ============================================================================ -->
       <!-- === Surface patches === -->
       <!-- ============================================================================ -->
       <complexType name="ThreeVertexSurfacePatchType">
            <complexContent>
                 <extension base="gml:AbstractSurfacePatchType">
                      <sequence>
                           <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="3"
maxOccurs="3"/>
                      </sequence>
                      <attribute name="interpolation" type="gml:SurfaceInterpolationType" fixed="planar"/>
                 </extension>
            </complexContent>
       </complexType>
       <!-- ..................... -->
       <element name="ThreeVertexSurfacePatch" type="geox:ThreeVertexSurfacePatchType"
substitutionGroup="gml:AbstractSurfacePatch">
            <annotation>
                 <documentation>Represents a triangle as a surface with an
    outer boundary defined by references to three Points.
    Note that this is a polygon (subtype) with no inner boundaries.
    Relative to a right-handed coordinate system the vertex sequence is counter-clockwise around the positive normal
vector
     A
     |
 0__| __2
```

```
 \  |  /
  \ | /
   1</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="ThreeVertexSurfacePatchPropertyType">
            <sequence minOccurs="0">
                <element ref="geox:ThreeVertexSurfacePatch"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="FourVertexSurfacePatchType">
            <complexContent>
                <extension base="gml:AbstractSurfacePatchType">
                    <sequence>
                        <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="4"
maxOccurs="4"/>
                    </sequence>
                    <attribute name="interpolation" type="gml:SurfaceInterpolationType" fixed="planar"/>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="FourVertexSurfacePatch" type="geox:FourVertexSurfacePatchType"
substitutionGroup="gml:AbstractSurfacePatch">
            <annotation>
                <documentation>Represents a quadrilateral as a surface with an
    outer boundary defined by references to four Points.
    The points must be co-planar.
    Note that this is a polygon (subtype) with no inner boundaries.
    Relative to a right-handed coordinate system the vertex sequence is counter-clockwise around the positive normal
vector
     A
     |
 0__| __3
  |   |   |
  |_____|
 1       2</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="FourVertexSurfacePatchPropertyType">
            <sequence minOccurs="0">
                <element ref="geox:FourVertexSurfacePatch"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <!-- === Specialised components used by geometries === -->
        <!-- ========================================================================== -->
        <!-- === properties === -->
        <!-- ========================================================================== -->
        <element name="triPatches" type="geox:TriArrayPropertyType" substitutionGroup="gml:patches">
            <annotation>
                <documentation>triMembers contains triangles, each of which is described using either the gml or xmml
forms.</documentation>
            </annotation>
        </element>
        <!-- ========================================================================== -->
        <complexType name="TriArrayPropertyType">
            <complexContent>
                <restriction base="gml:SurfacePatchArrayPropertyType">
                    <sequence minOccurs="0" maxOccurs="unbounded">
                        <element ref="geox:ThreeVertexSurfacePatch"/>
                    </sequence>
                </restriction>
            </complexContent>
        </complexType>
```

```
	<!-- ============================================================ -->
	<element name="quadPatches" type="geox:QuadArrayPropertyType" substitutionGroup="gml:patches">
		<annotation>
			<documentation>quadMembers contains quadrilateral patches, each of which is described using either
the gml or xmml forms.</documentation>
		</annotation>
	</element>
	<!-- ============================================================================ -->
	<complexType name="QuadArrayPropertyType">
		<complexContent>
			<restriction base="gml:SurfacePatchArrayPropertyType">
				<sequence minOccurs="0" maxOccurs="unbounded">
					<element ref="geox:FourVertexSurfacePatch"/>
				</sequence>
			</restriction>
		</complexContent>
	</complexType>
	<!-- ============================================================ -->
	<!-- ============================================================ -->
	<!--
How to implement a triangulated-surface
using geometryPrimitives.xsd
   Surface/patches/Triangle*/exterior/LinearRing/pos*
using xmml-geometry, vertices represented locally
   TriSurface/triPatches/gml:Triangle*/exterior/LinearRing/pos*
or if Points described elsewhere
    TriSurface/triPatches/geox:Triangle*/exterior3Points (has references to vertex id's)

How to implement a hexahedron:
using geometryPrimitives.xsd
   Solid/exterior/Surface/patches/Rectangle*/exterior/LinearRing
same pattern vertices represented locally
   Hexahedron/exterior/HexahedralSurface/quadPatches/gml:Rectangle*/exterior/LinearRing/pos*
or by reference
   Hexahedron/exterior/HexahedralSurface/quadPatches/geox:Rectangle*/exterior4Points

more compact patterns, ** require a fixed vertex sequence**:
vertices represented locally
    Hexahedron/pos[8]
or by reference
    Hexahedron/exterior8Points

 -->
	<!-- ============================================================ -->
</schema>
```

4.4 simpleSolids.xsd

This document implements a compact encoding for some simple solids, including Hexahedron, Wedge, Pyramid and Tetrahedron.

Listing 15. simpleSolids.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
targetNamespace="http://www.opengeospatial.net/geomExt/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
	<annotation>
		<documentation>
simpleSolids.xsd

A GML conformant schema for specialised geometries
simple solids

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
```

```
        </annotation>
        <!-- ========================================================================== -->
        <!-- bring in other schemas -->
        <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
        <include schemaLocation="./geometry.xsd"/>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <!-- ========================================================== -->
        <!-- === Solids === -->
        <!-- ========================================================== -->
        <complexType name="AbstractSimpleSolidType" abstract="true">
                <complexContent>
                        <extension base="gml:AbstractSolidType"/>
                </complexContent>
        </complexType>
        <!-- .............. -->
        <element name="AbstractSimpleSolid" type="geox:AbstractSimpleSolidType" abstract="true"
substitutionGroup="gml:AbstractSolid">
                <annotation>
                        <documentation>Head of substitution group for primitive Solids with simple descriptions.
</documentation>
                </annotation>
        </element>
        <!-- ................... -->
        <complexType name="AbstractSimpleSolidPropertyType">
                <sequence minOccurs="0">
                        <element ref="geox:AbstractSimpleSolid"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <!-- ========================================================== -->
        <complexType name="MultiSimpleSolidType">
                <complexContent>
                        <extension base="gml:AbstractGeometricAggregateType">
                                <sequence>
                                        <element name="member" type="geox:AbstractSimpleSolidPropertyType"
maxOccurs="unbounded"/>
                                </sequence>
                        </extension>
                </complexContent>
        </complexType>
        <!-- .............. -->
        <element name="MultiSimpleSolid" type="geox:MultiSimpleSolidType"
substitutionGroup="gml:AbstractGeometricAggregate">
                <annotation>
                        <documentation>Head of substitution group for multiSolids with simple descriptions. </documentation>
                </annotation>
        </element>
        <!-- ................... -->
        <complexType name="MultiSimpleSolidPropertyType">
                <sequence minOccurs="0">
                        <element ref="geox:MultiSimpleSolid"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="HexahedronType">
                <annotation>
                        <documentation>The "Hexahedron" element is a simple solid with eight vertices and six sides.
Relative to a right-handed coordinate system the vertex sequence is
   7____6
  / |   / |
4____5  |
|  3  _ |  2
| /     | /
0____1

For cases where the face order is used implicitly, then the faces are defined with the following vertices

0 - 0 1 5 4
```

```
1 - 1 2 6 5
2 - 2 3 7 6
3 - 3 0 4 7
4 - 0 3 2 1
5 - 7 4 5 6

    </documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractSimpleSolidType">
                    <sequence>
                        <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="8"
maxOccurs="8"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Hexahedron" type="geox:HexahedronType" substitutionGroup="geox:AbstractSimpleSolid">
            <annotation>
                <documentation>The "Hexahedron" element is a simple solid with eight vertices and six sides.
</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="WedgeType">
            <annotation>
                <documentation>The "Wedge" element is a simple solid with six vertices and five sides.
Relative to a right-handed coordinate system the vertex sequence is
     5
   /  | \
  /  4  \
 3 / -\- 2
  |/     \  |
 0____1

For cases where the face order is used implicitly, then the faces are defined with the following vertices

0 - 0 1 4
1 - 1 2 5 4
2 - 2 3 5
3 - 3 0 4 5
4 - 0 3 2 1

    </documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractSimpleSolidType">
                    <sequence>
                        <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="6"
maxOccurs="6"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Wedge" type="geox:WedgeType" substitutionGroup="geox:AbstractSimpleSolid">
            <annotation>
                <documentation>The "Wedge" element is a simple solid with six vertices and five sides.
</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="PyramidType">
            <annotation>
                <documentation>The "Pyramid" element is a simple solid with five vertices and five sides.
Relative to a right-handed coordinate system the vertex sequence is
    4
   //\\
 3 / -\- 2
  |/     \  |
```

0___1

For cases where the face order is used implicitly, then the faces are defined with the following vertices

0 - 0 1 4
1 - 1 2 4
2 - 2 3 4
3 - 3 0 4
4 - 0 3 2 1

```
    </documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractSimpleSolidType">
                    <sequence>
                        <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="5"
maxOccurs="5"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Pyramid" type="geox:PyramidType" substitutionGroup="geox:AbstractSimpleSolid">
            <annotation>
                <documentation>The "Pyramid" element is a simple solid with five vertices and five sides.
</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="TetrahedronType">
            <annotation>
                <documentation>The "Tetrahedron" element is a simple solid with four vertices and four sides.
Relative to a right-handed coordinate system the vertex sequence is
     3
   /  | \
 2- -| - -1
   \  |  /
     0

 For cases where the face order is used implicitly, then the faces are defined with the following vertices

1 - 1 2 3
2 - 2 0 3
0 - 0 1 3
3 - 0 2 1

    </documentation>
            </annotation>
            <complexContent>
                <extension base="geox:AbstractSimpleSolidType">
                    <sequence>
                        <element name="exteriorVertex" type="gml:PointPropertyType" minOccurs="4"
maxOccurs="4"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................... -->
        <element name="Tetrahedron" type="geox:TetrahedronType" substitutionGroup="geox:AbstractSimpleSolid">
            <annotation>
                <documentation>The "TetrahedronP" element is a simple solid with four vertices and four sides.
</documentation>
            </annotation>
        </element>
        <!-- ========================================================================== -->
</schema>
```

4.5 geometryProperties.xsd

This document implements some convenience Union classes, for 1D, 2D and 3D shapes, which are used in the implementation of the extensive sampling features.

Listing 16. geometryProperties.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
targetNamespace="http://www.opengeospatial.net/geomExt/0.0" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="pre-release">
	<annotation>
		<documentation>
geometryProperties.xsd

A GML conformant schema for some geometry extensions required for the Sampling schema

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
	</annotation>
	<!-- ========================================================================== -->
	<!-- bring in other schemas -->
	<import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
	<include schemaLocation="./simpleSolids.xsd"/>
	<include schemaLocation="./surfaces.xsd"/>
	<!-- ========================================================================== -->
	<!-- ========================================================== -->
	<complexType name="Shape1DPropertyType">
		<sequence minOccurs="0">
			<choice>
				<element ref="gml:LineString"/>
				<element ref="geox:MultiLineString"/>
				<element ref="geox:AbstractLine"/>
			</choice>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
		<attribute name="unionSemantics">
			<annotation>
				<documentation>optional XML attribute implements UML Union discriminator</documentation>
			</annotation>
			<simpleType>
				<restriction base="string">
					<enumeration value="lineSShape"/>
					<enumeration value="multiLineSShape"/>
					<enumeration value="lineVShape"/>
				</restriction>
			</simpleType>
		</attribute>
	</complexType>
	<!-- ========================================================================== -->
	<!-- ========================================================================== -->
	<complexType name="Shape2DPropertyType">
		<sequence minOccurs="0">
			<choice>
				<element ref="gml:Polygon"/>
				<element ref="geox:MultiPolygon"/>
				<element ref="geox:TriSurface"/>
				<element ref="geox:PlaneByVector"/>
			</choice>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
		<attribute name="unionSemantics">
			<annotation>
				<documentation>optional XML attribute implements UML Union discriminator</documentation>
			</annotation>
			<simpleType>
				<restriction base="string">
					<enumeration value="polyShape"/>
```

```
                        <enumeration value="multiPolyShape"/>
                        <enumeration value="triSShape"/>
                        <enumeration value="planeVShape"/>
                    </restriction>
                </simpleType>
            </attribute>
        </complexType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <complexType name="Shape3DPropertyType">
            <sequence minOccurs="0">
                <choice>
                    <element ref="geox:AbstractSimpleSolid"/>
                    <element ref="geox:MultiSimpleSolid"/>
                </choice>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attribute name="unionSemantics">
                <annotation>
                    <documentation>optional XML attribute implements UML Union discriminator</documentation>
                </annotation>
                <simpleType>
                    <restriction base="string">
                        <enumeration value="simpleSolidShape"/>
                        <enumeration value="multiSimpleSolidShape"/>
                    </restriction>
                </simpleType>
            </attribute>
        </complexType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <complexType name="ShapePolygonPropertyType">
            <sequence minOccurs="0">
                <choice>
                    <element ref="gml:Polygon"/>
                    <element ref="geox:MultiPolygon"/>
                </choice>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attribute name="unionSemantics">
                <annotation>
                    <documentation>optional XML attribute implements UML Union discriminator</documentation>
                </annotation>
                <simpleType>
                    <restriction base="string">
                        <enumeration value="polyShape"/>
                        <enumeration value="multiPolyShape"/>
                    </restriction>
                </simpleType>
            </attribute>
        </complexType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
</schema>
```

4.6 geomExt.xsd

This stub schema document collects all the geometry extensions. Use of this document in for external references to the geometry extension package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 17. geomExt.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
```

```
xmlns:geox="http://www.opengeospatial.net/geomExt/0.0"
targetNamespace="http://www.opengeospatial.net/geomExt/0.0" elementFormDefault="qualified" version="1.00">
	<xs:annotation>
		<xs:documentation>geomExt.xsd
	Utility geometry schema

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http://www.opengeospatial.org/about/?page=ipr</xs:documentation>
	</xs:annotation>
	<!-- ========================================================
	includes and imports
	======================================================== -->
	<xs:include schemaLocation="./geometryProperties.xsd"/>
</xs:schema>
```

5 Utility Schemas

5.1 Namespace

A set of schemas describe components used in several SWE encodings. These are in the namespace http://www.opengis.net/swe , except for simpleTypeDerivation.xsd which is in the namespace http://www.opengis.net/swe/st .

5.2 SWE_basicTypes.xsd

This schema defines a set of basic types to augment the types provided by GML. This includes in particular

– QualifiedMeasure, which extends the gml:Measure with a *qualifier* attribute to enable relative measures and nil values to be described

– TypedValue, which binds a semantic description to a value.

Listing 18. SWE_basicTypes.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:gml="http://www.opengis.net/gml" xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:swe="http://www.opengis.net/swe"
	targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
	version="pre-release">
	 <annotation>
		<documentation>basicTypes.xsd

Some basic types (simpleContent) required in various places in OWS Sensor Web application schemas

Copyright © 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
	</annotation>
	<!-- ========================================================================== -->
	<!-- ========================================================================== -->
	<simpleType name="UomIdentifier">
		<annotation>
			<documentation>Local copy of GML 3.2 uom identifier definition</documentation>
		</annotation>
		<union memberTypes="swe:UomSymbol swe:UomURI"/>
	</simpleType>
	<!-- ..... -->
	<simpleType name="UomSymbol">
		<restriction base="string">
			<pattern value="[^: \n\r\t]+"/>
		</restriction>
	</simpleType>
```

```
	<!-- ..... -->
	<simpleType name="UomURI">
		<restriction base="anyURI">
			<pattern value="([a-zA-Z][a-zA-Z0-9\-\+\.]*:|\.\./|\./|#).*"/>
		</restriction>
	</simpleType>
	<!-- ================================================================== -->
	<!-- ================================================================== -->
	<!-- ===== Types used for observation results ====== -->
	<!-- ================================================================== -->
	<complexType name="ScopedNameType">
		<annotation>
			<documentation>Explicit implementation of ISO 19103 ScopedName.
			Extension of string which also carries a codeSpace attribute.</documentation>
		</annotation>
		<simpleContent>
			<extension base="string">
				<attribute name="codeSpace" type="anyURI" use="required"/>
			</extension>
		</simpleContent>
	</complexType>
	<!-- ================================================================== -->
	<complexType name="QualifiedMeasureType">
		<annotation>
			<documentation>Elaboration of ISO 19103 Measure.
		Number with scale and optional qualifier.</documentation>
		</annotation>
		<simpleContent>
			<extension base="double">
				<attribute name="uom" type="swe:UomIdentifier" use="required"/>
				<attribute name="qualifier" type="swe:MeasureQualifierCode" default="equals"/>
			</extension>
		</simpleContent>
	</complexType>
	<!-- ..... -->
	<simpleType name="MeasureQualifierCode">
		<annotation>
			<documentation xml:lang="en">This enumerated data type specifies values for qualified
measures.</documentation>
		</annotation>
		<union>
			<simpleType>
				<restriction base="string">
					<enumeration value="lessThan"/>
					<enumeration value="lessThanOrEquals"/>
					<enumeration value="equals"/>
					<enumeration value="greaterThanOrEquals"/>
					<enumeration value="greaterThan"/>
					<enumeration value="nil:inapplicable"/>
					<enumeration value="nil:missing"/>
					<enumeration value="nil:unknown"/>
					<enumeration value="nil:withheld"/>
				</restriction>
			</simpleType>
			<simpleType>
				<restriction base="string">
					<annotation>
						<documentation>fall-through qualifier expressed as "other:aaaaaaa"</documentation>
					</annotation>
					<pattern value="other:\w{2,}">
					</pattern>
				</restriction>
			</simpleType>
			<simpleType>
				<restriction base="anyURI">
					<annotation>
						<documentation>Link to an external resource providing explanation</documentation>
					</annotation>
				</restriction>
			</simpleType>
		</union>
```

```
        </simpleType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <!-- ===== Soft-typed values and lists ====== -->
        <!-- ================================================================== -->
        <complexType name="TypedValueType">
            <annotation>
                <documentation>A generic soft-typed value</documentation>
            </annotation>
            <sequence>
                <element name="property" type="swe:ScopedNameType"/>
                <element name="value"/>
            </sequence>
        </complexType>
        <!-- ..................... -->
        <element name="TypedValue" type="swe:TypedValueType">
            <annotation>
                <documentation>A generic soft-typed value</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="TypedValuePropertyType">
            <sequence>
                <element ref="swe:TypedValue"/>
            </sequence>
        </complexType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <complexType name="IntervalType">
            <annotation>
                <documentation>A generic interval. The type of the two limits will normally be the
same.</documentation>
            </annotation>
            <sequence>
                <element name="lowerBound"/>
                <element name="upperBound"/>
            </sequence>
        </complexType>
        <!-- ..................... -->
        <element name="Interval" type="swe:IntervalType">
            <annotation>
                <documentation>A generic interval. The type of the two limits will normally be the
same.</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="IntervalPropertyType">
            <sequence>
                <element ref="swe:Interval"/>
            </sequence>
        </complexType>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
        <complexType name="TypedValueListType">
            <annotation>
                <documentation>A generic soft-typed list of values</documentation>
            </annotation>
            <sequence>
                <element name="property" type="swe:ScopedNameType"/>
                <element name="value" maxOccurs="unbounded"/>
            </sequence>
        </complexType>
        <!-- ..................... -->
        <element name="TypedValueList" type="swe:TypedValueListType">
            <annotation>
                <documentation>A generic soft-typed list of values</documentation>
            </annotation>
        </element>
        <!-- ..................... -->
        <complexType name="TypedValueListPropertyType">
```

```
            <sequence>
                <element ref="swe:TypedValueList"/>
            </sequence>
        </complexType>
        <!-- ========================================================================== -->
</schema>
```

5.3 aggregates.xsd

A basic schema for XML-encoded records and arrays (ISO/IEC 11404). Each Item within a record is soft-typed.

NOTE: This provides a simple encoding comparable to a row and a table.

Listing 19. aggregates.xsd

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:swe="http://www.opengis.net/swe"
    targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
    version="pre-release">
    <annotation>
        <documentation>A basic schema for data aggregates (Records and Arrays), using terminology consistent with
ISO 11404.

        A schema for the description of the record is given in recordType.xsd</documentation>
    </annotation>
    <!-- ============== -->
    <!-- ============== -->
    <element name="Item">
        <annotation>
            <documentation>An Item is an item of data of any type</documentation>
        </annotation>
    </element>
    <!-- ......  ...... -->
    <complexType name="ItemPropertyType">
        <sequence>
            <element ref="swe:Item"/>
        </sequence>
    </complexType>
    <!-- ============== -->
    <!-- ============== -->
    <complexType name="RecordType">
        <annotation>
            <documentation>A record is a list of fields</documentation>
        </annotation>
        <sequence>
            <element name="field" type="swe:ItemPropertyType" maxOccurs="unbounded">
                <annotation>
                    <documentation>A Record/field contains an item of data</documentation>
                </annotation>
            </element>
        </sequence>
        <attribute name="RS" type="anyURI" use="optional">
            <annotation>
                <documentation>Optional pointer to record-type schema</documentation>
            </annotation>
        </attribute>
    </complexType>
    <!-- ......  ...... -->
    <element name="Record" type="swe:RecordType">
        <annotation>
            <documentation>A record is a list of fields</documentation>
        </annotation>
    </element>
    <!-- ......  ...... -->
```

```
	<complexType name="RecordPropertyType">
		<sequence>
			<element ref="swe:Record"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<!-- ============== -->
	<complexType name="ArrayType">
		<annotation>
			<documentation>An array is an indexed set of records of homogeneous type</documentation>
		</annotation>
		<sequence>
			<element name="element" type="swe:ElementPropertyType" maxOccurs="unbounded">
				<annotation>
					<documentation>An Array/element contains an Item or a Record or an
Array</documentation>
				</annotation>
			</element>
		</sequence>
		<attribute name="RS" type="anyURI" use="optional">
			<annotation>
				<documentation>Optional pointer to the record-type schema. This should be used when the
elements of the array are Records</documentation>
			</annotation>
		</attribute>
	</complexType>
	<!-- ......  ...... -->
	<element name="Array" type="swe:ArrayType">
		<annotation>
			<documentation>An array is an indexed set of records of homogeneous type</documentation>
		</annotation>
	</element>
	<!-- ......  ...... -->
	<complexType name="ArrayPropertyType">
		<sequence>
			<element ref="swe:Array"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<complexType name="ElementPropertyType">
		<annotation>
			<documentation>Choice of Item or Record or Array - used in composing Arrays</documentation>
		</annotation>
		<group ref="swe:XMLaggregate"/>
	</complexType>
	<!-- ============== -->
	<group name="XMLaggregate">
		<annotation>
			<documentation>Convenience group that bundles all the soft-typed XML-encoded aggregates into a
choice group</documentation>
		</annotation>
		<choice>
			<element ref="swe:Item"/>
			<element ref="swe:Record"/>
			<element ref="swe:Array"/>
		</choice>
	</group>
	<!-- ============== -->
</schema>
```

5.4 temporalAggregates.xsd

This extends the ISO 19108 temporal schema adding temporal aggregates and temporal grids, as required for descriptions of complex time objects.

Listing 20. temporalAggregates.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:swe="http://www.opengis.net/swe"
targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
version="pre-release">
	<annotation>
		<documentation>
temporalAggregates.xsd

time geometric complex, time aggregates and time grids

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</documentation>
	</annotation>
	<!-- ================================================================== -->
	<!-- bring in other schemas -->
	<import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
	<!-- ================================================================== -->
	<!-- ========================================================== -->
	<!-- ================================================================== -->
	<simpleType name="TimeValueList">
	<annotation><documentation>Compact list of time instants, following gml:posList pattern.
</documentation></annotation>
		<list itemType="gml:TimePositionUnion"/>
	</simpleType>
	<!-- ================================================================== -->
	<complexType name="TimePositionListType">
		<annotation>
			<documentation>TimePositionList instances hold a sequence of time positions within the same
frame.</documentation>
		</annotation>
		<simpleContent>
			<extension base="swe:TimeValueList">
				<attribute name="frame" type="anyURI" use="optional" default="#ISO-8601"/>
				<attribute name="calendarEraName" type="string" use="optional"/>
				<attribute name="indeterminatePosition" type="gml:TimeIndeterminateValueType" use="optional"/>
				<attribute name="count" type="positiveInteger" use="optional">
					<annotation>
						<documentation>"count" allows to specify the number of direct positions in the list.
</documentation>
					</annotation>
				</attribute>
			</extension>
		</simpleContent>
	</complexType>
	<!-- ========================================================== -->
	<!-- ===== Missing property types ====== -->
	<!-- ================================================================== -->
	<complexType name="TimeGeometricPrimitivePropertyType">
	<annotation><documentation>Property type not provided by GML</documentation></annotation>
		<sequence minOccurs="0">
			<element ref="gml:AbstractTimeGeometricPrimitive"/>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
	</complexType>
	<!-- ================================================================== -->
	<!-- ===== Time geometric complexes ====== -->
	<!-- ================================================================== -->
	<complexType name="TimeGeometricComplexType">
	<annotation><documentation>Explicit implementation of ISO 19108 TM_GeometricComplex - a self-consistent set
of TimeInstants and TimePeriods</documentation></annotation>
		<complexContent>
			<extension base="gml:AbstractTimeComplexType">
				<sequence>
					<element name="primitive" type="swe:TimeGeometricPrimitivePropertyType"
maxOccurs="unbounded">
						<annotation>
							<documentation>Reference to an identified time
primitive</documentation>
```

```
                                        </annotation>
                                    </element>
                                </sequence>
                            </extension>
                        </complexContent>
                    </complexType>
                    <!-- ..... -->
                    <element name="TimeGeometricComplex" type="swe:TimeGeometricComplexType"
substitutionGroup="gml:AbstractTimeComplex">
                    <annotation><documentation>Explicit implementation of ISO 19108 TM_GeometricComplex - a self-consistent set
of TimeInstants and TimePeriods</documentation></annotation>
                    </element>
                    <!-- ..... -->
                    <complexType name="TimeGeometricComplexPropertyType">
                        <sequence minOccurs="0">
                            <element ref="swe:TimeGeometricComplex"/>
                        </sequence>
                        <attributeGroup ref="gml:AssociationAttributeGroup"/>
                    </complexType>
                    <!-- ================================== -->
                    <!-- ===== Time aggregates ====== -->
                    <!-- ================================================================ -->
                    <!-- ===== Explicit time aggregates ====== -->
                    <!-- ================================================================ -->
                    <complexType name="TimeObjectPropertyType">
                    <annotation><documentation>Property type not provided by GML</documentation></annotation>
                        <sequence minOccurs="0">
                            <element ref="gml:AbstractTimeObject"/>
                        </sequence>
                        <attributeGroup ref="gml:AssociationAttributeGroup"/>
                    </complexType>
                    <!-- ================================================================ -->
                    <complexType name="TimeAggregateType">
                        <annotation>
                            <documentation>an arbitrary set of TimeObjects, often TimeInstants and TimePeriods</documentation>
                        </annotation>
                        <complexContent>
                            <extension base="gml:AbstractTimeObjectType">
                                <sequence>
                                    <element name="member" type="swe:TimeObjectPropertyType" maxOccurs="unbounded"/>
                                </sequence>
                            </extension>
                        </complexContent>
                    </complexType>
                    <!-- ..... -->
                    <element name="TimeAggregate" type="swe:TimeAggregateType" substitutionGroup="gml:AbstractTimeObject">
                        <annotation>
                            <documentation>an arbitrary set of TimeObjects, often TimeInstants and TimePeriods</documentation>
                        </annotation>
                    </element>
                    <!-- ..... -->
                    <complexType name="TimeAggregatePropertyType">
                        <sequence minOccurs="0">
                            <element ref="swe:TimeAggregate"/>
                        </sequence>
                        <attributeGroup ref="gml:AssociationAttributeGroup"/>
                    </complexType>
                    <!-- ================================== -->
                    <!-- ===== Implicit time aggregates ====== -->
                    <!-- ================================================================ -->
                    <complexType name="TimeGridType">
                        <annotation>
                            <documentation>A set of uniformly spaced time instants described using an implicit notation.
    Follow pattern of (ISO 19123) spatial grids:
 these have (dimension,axisName,extent(,origin,offsetVector))
 For temporal case, dimension is fixed (1), axisName is fixed ("time")</documentation>
                        </annotation>
                        <complexContent>
                            <extension base="gml:AbstractTimeComplexType">
                                <sequence>
                                    <element name="extent" type="swe:TimeGridExtentType"/>
```

```
                        <choice>
                            <element name="originPos" type="gml:TimePositionType">
                                <annotation>
                                    <documentation>Simple-content time position</documentation>
                                </annotation>
                            </element>
                            <element name="origin" type="gml:TimeInstantPropertyType">
                                <annotation>
                                    <documentation>Reference to an identified time instant</documentation>
                                </annotation>
                            </element>
                        </choice>
                        <choice>
                            <element name="offsetDuration" type="duration">
                                <annotation>
                                    <documentation>XML Schema built-in simple type for duration: e.g.
        P1Y (1 year)
        P1M (1 month)
        P1DT12H (1 day 12 hours)
        PT5M (5 minutes)
        PT0.007S (7 milliseconds)</documentation>
                                </annotation>
                            </element>
                            <element name="offsetInterval" type="gml:TimeIntervalLengthType">
                                <annotation>
                                    <documentation>representation of the ISO 11404 model of a time interval
length: e.g.
        value=1, unit="year"
        value=1, unit="other:month" (or see next)
        value=1, unit="year" radix="12" factor="1" (1/12 year)
        value=1.5, unit="day"
        value=36, unit="hour"
        value=5, unit="minute"
        value=7, unit="second" radix="10" factor="3" (7 milliseconds)</documentation>
                                </annotation>
                            </element>
                        </choice>
                        <element name="duration" type="duration" minOccurs="0"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="TimeGrid" type="swe:TimeGridType" abstract="true"
substitutionGroup="gml:AbstractTimeComplex">
            <annotation>
                <documentation>A set of uniformly spaced time instants described using an implicit notation
                    Follow pattern of (ISO 19123) spatial grids:
 these have (dimension,axisName,extent(,origin,offsetVector))
 For temporal case, dimension is fixed (1), axisName is fixed ("time")</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="TimeGridPropertyType">
            <sequence minOccurs="0">
                <element ref="swe:TimeInstantGrid"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="TimeGridExtentType">
            <sequence>
                <element name="SeriesEnvelope">
                    <annotation>
                        <documentation>Grid extent specified in grid coordinates - i.e. 2 integers</documentation>
                    </annotation>
                    <complexType>
                        <sequence>
                            <element name="low" type="integer"/>
                            <element name="high" type="integer"/>
                        </sequence>
```

```
                        </complexType>
                    </element>
                </sequence>
            </complexType>
            <!-- ================================================================== -->
            <complexType name="TimeInstantGridType">
                <annotation>
                    <documentation>Extend time instant grid with window size property</documentation>
                </annotation>
                <complexContent>
                    <extension base="swe:TimeGridType">
                    </extension>
                </complexContent>
            </complexType>
            <!-- ..................... -->
            <element name="TimeInstantGrid" type="swe:TimeInstantGridType" substitutionGroup="swe:TimeGrid">
                <annotation>
                    <documentation>A set of uniformly spaced time instants described using an implicit
notation</documentation>
                </annotation>
            </element>
            <!-- ..................... -->
            <complexType name="TimeInstantGridPropertyType">
                <sequence minOccurs="0">
                    <element ref="swe:TimeInstantGrid"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
            </complexType>
            <!-- ================================================================== -->
            <complexType name="TimeIntervalGridType">
                <annotation>
                    <documentation>Extend time instant grid with window size property</documentation>
                </annotation>
                <complexContent>
                    <extension base="swe:TimeGridType">
                        <sequence>
                            <choice>
                                <element name="windowDuration" type="duration">
                                    <annotation>
                                        <documentation>XML Schema built-in simple type for
duration</documentation>
                                    </annotation>
                                </element>
                                <element name="windowInterval" type="gml:TimeIntervalLengthType">
                                    <annotation>
                                        <documentation>representation of the ISO 11404 model of a time interval
length</documentation>
                                    </annotation>
                                </element>
                            </choice>
                        </sequence>
                    </extension>
                </complexContent>
            </complexType>
            <!-- ..................... -->
            <element name="TimeIntervalGrid" type="swe:TimeIntervalGridType" substitutionGroup="swe:TimeGrid">
                <annotation>
                    <documentation>A set of uniformly spaced time intervals described using an implicit
notation</documentation>
                </annotation>
            </element>
            <!-- ..................... -->
            <complexType name="TimeIntervalGridPropertyType">
                <sequence minOccurs="0">
                    <element ref="swe:TimeIntervalGrid"/>
                </sequence>
                <attributeGroup ref="gml:AssociationAttributeGroup"/>
            </complexType>
            <!-- ================================================================== -->
</schema>
```

5.5 discreteCoverage.xsd

This document implements the Discrete classes described in sub-clause 6.5.3, and shown in Figure 3.

Note that two versions of the discrete coverages are provided:

– CV_DiscreteCoverage, CV_DiscretePointCoverage, CV_DiscreteTimeInstantCoverage and CV_ElementCoverageObservation implement the classes shown in Figure 3 in an explicit form

– in CompactDiscreteCoverage, CompactDiscretePointCoverage and CompactDiscreteTimeCoverage the domain objects are restricted to spatio-temporal point geometry.

Listing 21. discreteCoverage.xsd

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:swe="http://www.opengis.net/swe"
xmlns:gml="http://www.opengis.net/gml"
      targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
      version="pre-release">
       <annotation>
            <documentation>An explicit representation of the CV_DiscreteCoverage, interleaved model, from ISO 19123
            All items are XML encoded

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       </annotation>
       <!-- ============== -->
       <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
       <!-- ============== -->
       <include schemaLocation="./aggregates.xsd"/>
       <include schemaLocation="./temporalAggregates.xsd"/>
       <!-- ============== -->
       <complexType name="CV_DomainObjectType">
            <annotation>
                 <documentation>Explicit implementation of ISO 19123 CV_DomainObject</documentation>
            </annotation>
            <sequence>
                 <element name="spatialElement" minOccurs="0" maxOccurs="unbounded"
type="gml:GeometryPropertyType"/>
                 <element name="temporalElement" minOccurs="0" maxOccurs="unbounded"
type="swe:TimeGeometricPrimitivePropertyType"/>
            </sequence>
       </complexType>
       <!-- ............... -->
       <element name="CV_DomainObject" type="swe:CV_DomainObjectType">
            <annotation>
                 <documentation>Explicit implementation of ISO 19123 CV_DomainObject</documentation>
            </annotation>
       </element>
       <!-- ............... -->
       <complexType name="CV_DomainObjectPropertyType">
            <sequence minOccurs="0">
                 <element ref="swe:CV_DomainObject"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
       </complexType>
       <!-- ============== -->
       <!-- ============== -->
       <!-- === Implementations of CV_GeometryValuePair and specializations === -->
       <!-- ============== -->
       <complexType name="CV_AbstractGeometryValuePairType">
```

```
            <annotation>
                <documentation>Head of substitution group of ISO 19123 CV_GeometryValuePair and specializations
        - concrete types derived from this must add geometry and value properties of a suitable type</documentation>
            </annotation>
            <!--
            <sequence>
                <element name="geometry"/>
                <element name="value"/>
            </sequence>
                -->
        </complexType>
        <!-- ..... -->
        <element name="CV_AbstractGeometryValuePair" type="swe:CV_AbstractGeometryValuePairType"
abstract="true">
            <annotation>
                <documentation>Head of substitution group of ISO 19123 CV_GeometryValuePair and specializations
        - concrete types derived from this must add geometry and value properties of a suitable type</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CV_AbstractGeometryValuePairPropertyType">
            <sequence>
                <element ref="swe:CV_AbstractGeometryValuePair"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CV_GeometryValuePairType">
            <annotation>
                <documentation>Explicit implementation of ISO 19123 CV_GeometryValuePair - this is the most general
case, and is a literal encoding of the model.
                It is implemented as a sibling of specialized versions because of XML Schema derivation by restriction
gotchas.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractGeometryValuePairType">
                    <sequence>
                        <element name="geometry" type="swe:CV_DomainObjectPropertyType"/>
                        <element name="value">
                            <annotation>
                                <documentation>Implicitly xs:anyType. Usually select one from
                                    (a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
                                    (b) swe:ElementPropertyType</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="CV_GeometryValuePair" type="swe:CV_GeometryValuePairType"
            substitutionGroup="swe:CV_AbstractGeometryValuePair">
            <annotation>
                <documentation>Explicit implementation of ISO 19123 CV_GeometryValuePair - this is the most general
case, and is a literal encoding of the model.
                It is implemented as a sibling of specialized versions because of XML Schema derivation by restriction
gotchas.</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CV_GeometryValuePairPropertyType">
            <sequence>
                <element ref="swe:CV_GeometryValuePair"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CV_PointValuePairType">
            <annotation>
                <documentation>Specialization of ISO 19123 CV_GeometryValuePair.
                Explicit implementation of ISO 19123 CV_PointValuePair - this is a literal encoding of the
model.</documentation>
```

```
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractGeometryValuePairType">
                    <sequence>
                        <element name="geometry" type="gml:PointPropertyType"/>
                        <element name="value">
                            <annotation>
                                <documentation>Implicitly xs:anyType. Usually select one from
                                    (a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
                                    (b) swe:ElementPropertyType</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="CV_PointValuePair" type="swe:CV_PointValuePairType"
substitutionGroup="swe:CV_AbstractGeometryValuePair">
            <annotation>
                <documentation>Specialization of ISO 19123 CV_GeometryValuePair.
                Explicit implementation of ISO 19123 CV_PointValuePair - this is a literal encoding of the
model.</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CV_PointValuePairPropertyType">
            <sequence>
                <element ref="swe:CV_PointValuePair"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CV_TimeInstantValuePairType">
            <annotation>
                <documentation>Specialization of ISO 19123 CV_GeometryValuePair.
                Explicit implementation of CV_TimeInstantValuePair - this is the temporal equivalent to
CV_PointValuePair.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractGeometryValuePairType">
                    <sequence>
                        <element name="geometry" type="gml:TimeInstantPropertyType"/>
                        <element name="value">
                            <annotation>
                                <documentation>Implicitly xs:anyType. Usually select one from
                                    (a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
                                    (b) swe:ElementPropertyType</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="CV_TimeInstantValuePair" type="swe:CV_TimeInstantValuePairType"
            substitutionGroup="swe:CV_AbstractGeometryValuePair">
            <annotation>
                <documentation>Specialization of ISO 19123 CV_GeometryValuePair.
                Explicit implementation of CV_TimeInstantValuePair - this is the temporal equivalent to
CV_PointValuePair.</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CV_TimeInstantValuePairPropertyType">
            <sequence>
                <element ref="swe:CV_TimeInstantValuePair"/>
            </sequence>
        </complexType>
        <!-- ============== -->
```

```
	<complexType name="CV_ElementValuePairType">
		<annotation>
			<documentation>Specialization of ISO 19123 CV_GeometryValuePair.
			Explicit implementation of CV_ElementValuePair -  the "geometry" property carries a pointer to an object which acts as the geometry-provider.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractGeometryValuePairType">
				<sequence>
					<element name="geometry" type="gml:ReferenceType">
						<annotation>
							<documentation>In a CV_ElementValuePair the "geometry" property carries a pointer to an object which acts as the geometry-provider.</documentation>
						</annotation>
					</element>
					<element name="value">
						<annotation>
							<documentation>Implicitly xs:anyType. Usually select one from
								(a) observation result simple types - gml:MeasureType, swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
								(b) swe:ElementPropertyType</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..... -->
	<element name="CV_ElementValuePair" type="swe:CV_ElementValuePairType" substitutionGroup="swe:CV_AbstractGeometryValuePair">
		<annotation>
			<documentation>Specialization of ISO 19123 CV_GeometryValuePair.
			Explicit implementation of CV_ElementValuePair -  the "geometry" property carries a pointer to an object which acts as the geometry-provider.</documentation>
		</annotation>
	</element>
	<!-- ..... -->
	<complexType name="CV_ElementValuePairPropertyType">
		<sequence>
			<element ref="swe:CV_ElementValuePair"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<!-- === Implementations of CV_DiscreteCoverage and specializations === -->
	<!-- ============== -->
	<complexType name="CV_AbstractDiscreteCoverageType">
		<annotation>
			<documentation>Head of substitution group implementing ISO 19123 CV_DiscreteCoverage and specializations.
			Concrete descendants must add an "element" property of a suitable type.</documentation>
		</annotation>
		<sequence>
			<!--
			<element name="element" type="swe:CV_AbstractGeometryValuePairPropertyType" maxOccurs="unbounded"/>
			-->
		</sequence>
	</complexType>
	<!-- ..... -->
	<element name="CV_AbstractDiscreteCoverage" type="swe:CV_AbstractDiscreteCoverageType" abstract="true">
		<annotation>
			<documentation>Head of substitution group implementing ISO 19123 CV_DiscreteCoverage and specializations.
			Concrete descendants must add an "element" property of a suitable type.</documentation>
		</annotation>
	</element>
	<!-- ..... -->
	<complexType name="CV_AbstractDiscreteCoveragePropertyType">
		<sequence>
			<element ref="swe:CV_AbstractDiscreteCoverage"/>
		</sequence>
```

```
	</complexType>
	<!-- ============== -->
	<complexType name="CV_DiscreteCoverageType">
		<annotation>
			<documentation>Explicit implementation of ISO 19123 CV_DiscreteCoverage.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractDiscreteCoverageType">
				<sequence>
					<element name="element" type="swe:CV_GeometryValuePairPropertyType"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ........... -->
	<element name="CV_DiscreteCoverage" type="swe:CV_DiscreteCoverageType"
substitutionGroup="swe:CV_AbstractDiscreteCoverage">
		<annotation>
			<documentation>Explicit implementation of ISO 19123 CV_DiscreteCoverage.</documentation>
		</annotation>
	</element>
	<!-- ........... -->
	<complexType name="CV_DiscreteCoveragePropertyType">
		<sequence>
			<element ref="swe:CV_DiscreteCoverage"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<complexType name="CV_DiscretePointCoverageType">
		<annotation>
			<documentation>Explicit implementation of ISO 19123 CV_DiscretePointCoverage.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractDiscreteCoverageType">
				<sequence>
					<element name="element" type="swe:CV_PointValuePairPropertyType"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ........... -->
	<element name="CV_DiscretePointCoverage" type="swe:CV_DiscretePointCoverageType"
		substitutionGroup="swe:CV_AbstractDiscreteCoverage">
		<annotation>
			<documentation>Explicit implementation of ISO 19123 CV_DiscretePointCoverage.</documentation>
		</annotation>
	</element>
	<!-- ........... -->
	<complexType name="CV_DiscretePointCoveragePropertyType">
		<sequence>
			<element ref="swe:CV_DiscretePointCoverage"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<complexType name="CV_DiscreteTimeInstantCoverageType">
		<annotation>
			<documentation>Explicit implementation of specialized CV_DiscreteCoverage in which the coverage
domain is composed of time-instants.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractDiscreteCoverageType">
				<sequence>
					<element name="element" type="swe:CV_TimeInstantValuePairPropertyType"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ........... -->
```

```
	<element name="CV_DiscreteTimeInstantCoverage" type="swe:CV_DiscreteTimeInstantCoverageType"
		substitutionGroup="swe:CV_AbstractDiscreteCoverage">
		<annotation>
			<documentation>Explicit implementation of specialized CV_DiscreteCoverage in which the coverage
domain is composed of time-instants.</documentation>
		</annotation>
	</element>
	<!-- ..... -->
	<complexType name="CV_DiscreteTimeInstantCoveragePropertyType">
		<sequence>
			<element ref="swe:CV_DiscreteTimeInstantCoverage"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<complexType name="CV_DiscreteElementCoverageType">
		<annotation>
			<documentation>Explicit implementation of specialized CV_DiscreteCoverage in which the coverage
domain is composed of pointers to objects that act as geometry-providers.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractDiscreteCoverageType">
				<sequence>
					<element name="element" type="swe:CV_ElementValuePairPropertyType"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ..... -->
	<element name="CV_DiscreteElementCoverage" type="swe:CV_DiscreteElementCoverageType"
		substitutionGroup="swe:CV_AbstractDiscreteCoverage">
		<annotation>
			<documentation>Explicit implementation of specialized CV_DiscreteCoverage in which the coverage
domain is composed of pointers to objects that act as geometry-providers.</documentation>
		</annotation>
	</element>
	<!-- ..... -->
	<complexType name="CV_DiscreteElementCoveragePropertyType">
		<sequence>
			<element ref="swe:CV_DiscreteElementCoverage"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<!-- ============== -->
	<!-- ============== -->
	<complexType name="CompactDomainObjectType">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_DomainObject, in which the spatial and temporal
elements are encoded directly.</documentation>
		</annotation>
		<sequence>
			<element name="spatialElement" minOccurs="0" maxOccurs="unbounded"
type="gml:DirectPositionType"/>
			<element name="temporalElement" minOccurs="0" maxOccurs="unbounded"
type="gml:TimePositionType"/>
		</sequence>
	</complexType>
	<!-- ..... -->
	<element name="CompactDomainObject" type="swe:CompactDomainObjectType">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_DomainObject, in which the spatial and temporal
elements are encoded directly.</documentation>
		</annotation>
	</element>
	<!-- ..... -->
	<complexType name="CompactDomainObjectPropertyType">
		<sequence minOccurs="0">
			<element ref="swe:CompactDomainObject"/>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
	</complexType>
```

```
	<!-- ============== -->
	<!-- ============== -->
	<complexType name="CompactGeometryValuePairType">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_GeometryValuePair, in which the spatial and
temporal elements of the geometry are encoded directly.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractGeometryValuePairType">
				<sequence>
					<element name="geometry" type="swe:CompactDomainObjectPropertyType"/>
					<element name="value">
						<annotation>
							<documentation>Implicitly xs:anyType. Usually select one from
								(a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
								(b) swe:ElementPropertyType</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ........... -->
	<element name="CompactGeometryValuePair" type="swe:CompactGeometryValuePairType"
		substitutionGroup="swe:CV_AbstractGeometryValuePair">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_GeometryValuePair, in which the spatial and
temporal elements of the geometry are encoded directly.</documentation>
		</annotation>
	</element>
	<!-- ........... -->
	<complexType name="CompactGeometryValuePairPropertyType">
		<sequence>
			<element ref="swe:CompactGeometryValuePair"/>
		</sequence>
	</complexType>
	<!-- ============== -->
	<complexType name="CompactPointValuePairType">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_PointValuePair, in which the geometry is
encoded directly.</documentation>
		</annotation>
		<complexContent>
			<extension base="swe:CV_AbstractGeometryValuePairType">
				<sequence>
					<element name="geometry" type="gml:DirectPositionType"/>
					<element name="value">
						<annotation>
							<documentation>Implicitly xs:anyType. Usually select one from
								(a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
								(b) swe:ElementPropertyType</documentation>
						</annotation>
					</element>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ........... -->
	<element name="CompactPointValuePair" type="swe:CompactPointValuePairType"
		substitutionGroup="swe:CV_AbstractGeometryValuePair">
		<annotation>
			<documentation>Compact equivalent to ISO 19123 CV_PointValuePair, in which the geometry is
encoded directly.</documentation>
		</annotation>
	</element>
	<!-- ........... -->
	<complexType name="CompactPointValuePairPropertyType">
		<sequence>
			<element ref="swe:CompactPointValuePair"/>
```

```
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CompactTimeValuePairType">
            <annotation>
                <documentation>Compact equivalent to CV_TimeInstantValuePair, in which the geometry is encoded
directly.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractGeometryValuePairType">
                    <sequence>
                        <element name="geometry" type="gml:TimePositionType"/>
                        <element name="value">
                            <annotation>
                                <documentation>Implicitly xs:anyType. Usually select one from
                                    (a) observation result simple types - gml:MeasureType,
swe:QualifiedMeasureType, swe:ScopedNameType, integer, boolean
                                    (b) swe:ElementPropertyType</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ........... -->
        <element name="CompactTimeValuePair" type="swe:CompactTimeValuePairType"
            substitutionGroup="swe:CV_AbstractGeometryValuePair">
            <annotation>
                <documentation>Compact equivalent to CV_TimeInstantValuePair, in which the geometry is encoded
directly.</documentation>
            </annotation>
        </element>
        <!-- ........... -->
        <complexType name="CompactTimeValuePairPropertyType">
            <sequence>
                <element ref="swe:CompactTimeValuePair"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <!-- ============== -->
        <!-- ============== -->
        <complexType name="CompactDiscreteCoverageType">
            <annotation>
                <documentation>Head of substitution group for compact discrete coverage encodings</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractDiscreteCoverageType">
                    <sequence>
                        <element name="element" type="swe:CompactGeometryValuePairPropertyType"
maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ........... -->
        <element name="CompactDiscreteCoverage" type="swe:CompactDiscreteCoverageType"
            substitutionGroup="swe:CV_AbstractDiscreteCoverage">
            <annotation>
                <documentation>Head of substitution group for compact discrete coverage encodings</documentation>
            </annotation>
        </element>
        <!-- ........... -->
        <complexType name="CompactDiscreteCoveragePropertyType">
            <sequence>
                <element ref="swe:CompactDiscreteCoverage"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CompactDiscretePointCoverageType">
            <annotation>
```

```
                <documentation>Compact equivalent to ISO 19123 CV_DiscretePointCoverage, in which the domain
geometry is encoded directly.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractDiscreteCoverageType">
                    <sequence>
                        <element name="element" type="swe:CompactPointValuePairPropertyType"
maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="CompactDiscretePointCoverage" type="swe:CompactDiscretePointCoverageType"
            substitutionGroup="swe:CV_AbstractDiscreteCoverage">
            <annotation>
                <documentation>Compact equivalent to ISO 19123 CV_DiscretePointCoverage, in which the domain
geometry is encoded directly.</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CompactDiscretePointCoveragePropertyType">
            <sequence>
                <element ref="swe:CompactDiscretePointCoverage"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <complexType name="CompactDiscreteTimeCoverageType">
            <annotation>
                <documentation>Compact equivalent to CV_DiscreteTimeInstantCoverage, in which the domain
geometry is encoded directly.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CV_AbstractDiscreteCoverageType">
                    <sequence>
                        <element name="element" type="swe:CompactTimeValuePairPropertyType"
maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..... -->
        <element name="CompactDiscreteTimeCoverage" type="swe:CompactDiscreteTimeCoverageType"
            substitutionGroup="swe:CV_AbstractDiscreteCoverage">
            <annotation>
                <documentation>Compact equivalent to CV_DiscreteTimeInstantCoverage, in which the domain
geometry is encoded directly.</documentation>
            </annotation>
        </element>
        <!-- ..... -->
        <complexType name="CompactDiscreteTimeCoveragePropertyType">
            <sequence>
                <element ref="swe:CompactDiscreteTimeCoverage"/>
            </sequence>
        </complexType>
        <!-- ============== -->
        <group name="XMLdata">
            <annotation>
                <documentation>Convenience group that bundles all the soft-typed XML-encoded aggregates and
coverages into a choice group</documentation>
            </annotation>
            <choice>
                <group ref="swe:XMLaggregate"/>
                <element ref="swe:CV_DiscreteCoverage"/>
            </choice>
        </group>
        <!-- ============== -->
</schema>
```

5.6 recordType.xsd

A basic recordType schema is shown in Figure 12.

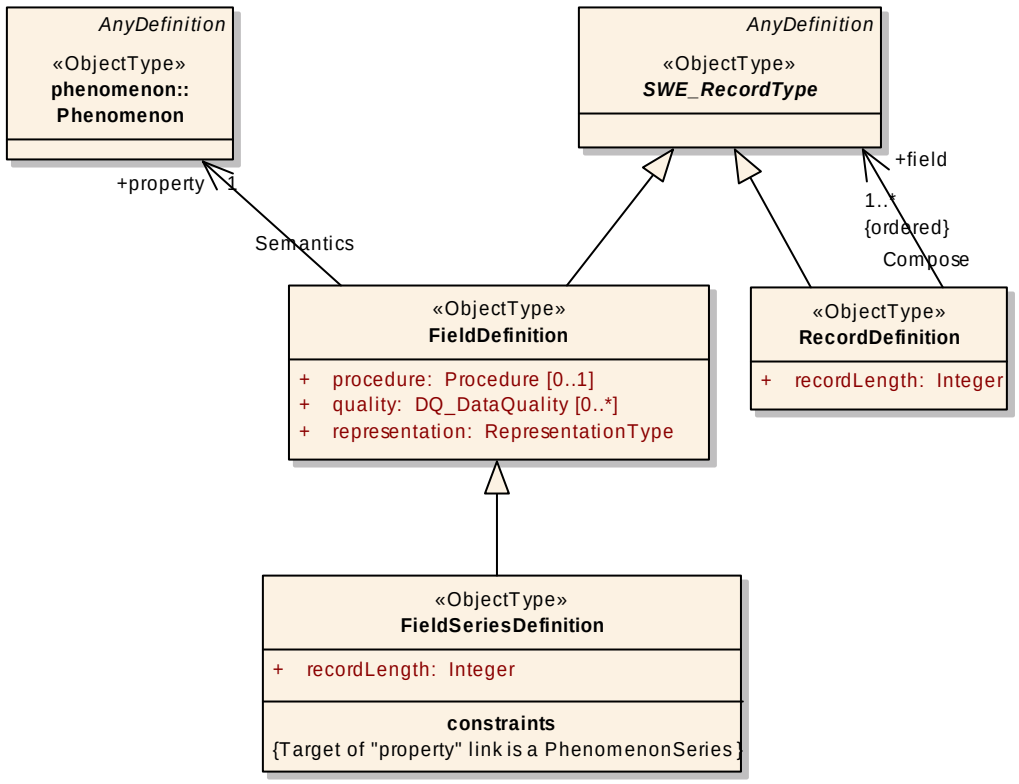

Figure 12. Simple schema for record types

This provides for a simple RecordDefinition composed of an ordered set of ItemDefinition elements. This reflects the Record structure described in sub-clause **Error! Reference source not found.**. Each ItemDefinition includes the semantics ("property") and representation for the item, and optionally a reference to the procedure used and quality.

NOTE: This provides a simple encoding comparable to the "column headings" from a table.

The "representation" property is implemented using a minor adaptation of the W3C "schema-for-schemas" for simpleType components as described in sub-clause 5.7.

Listing 22. recordType.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:swe="http://www.opengis.net/swe"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gml="http://www.opengis.net/gml"
 xmlns:xst="http://www.opengis.net/swe/st"
targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
version="pre-release">
        <annotation>
```

```
            <documentation>recordSchema.xsd

A GML conformant schema
for definitions of record structures composed of lists of items
using terminology consistent withe ISO 11404.

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
        </annotation>
        <!-- ============================================================================ -->
        <!-- bring in other schemas -->
        <import namespace="http://www.opengis.net/swe/st" schemaLocation="./simpleTypeDerivation.xsd">
            <annotation>
                <documentation>SimpleType derivation components from W3C XML Schema specification.
                These have been cloned and loaded into a new namespace,
                because standard processors have these definitions "pre-loaded", which does not allow them to be
declared for use in instance documents.</documentation>
            </annotation>
        </import>
        <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
        <include schemaLocation="./phenomenon.xsd"/>
        <!-- ============================================================================ -->
        <!-- ============================================================================ -->
        <complexType name="RecordTypeType">
            <annotation>
                <documentation>Abstract element used as head of a substitution group for axis and record definitions
                Implementation of ISO 11404/19103 RecordType</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:DefinitionType"/>
            </complexContent>
        </complexType>
        <!-- ......... -->
        <element name="RecordType" type="swe:RecordTypeType" abstract="true" substitutionGroup="gml:Definition">
            <annotation>
                <documentation>Abstract element used as head of a substitution group for axis and record definitions
                Implementation of ISO 11404/ 19103 RecordType</documentation>
            </annotation>
        </element>
        <!-- ..................................... -->
        <complexType name="RecordTypePropertyType">
            <sequence minOccurs="0">
                <element ref="swe:RecordType"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ============================================================================ -->
        <complexType name="ItemDefinitionType">
            <annotation>
                <documentation>Description of a scalar property with its representation and scale and (optional)
estimation procedure.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:RecordTypeType">
                    <sequence>
                        <element name="procedure" type="gml:ReferenceType" minOccurs="0"/>
                        <element name="property" type="swe:PhenomenonPropertyType"/>
                        <element name="representation" type="swe:RepresentationType"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="ItemDefinition" type="swe:ItemDefinitionType" substitutionGroup="swe:RecordType">
            <annotation>
                <documentation>Description of a scalar property with its representation and scale and (optional)
estimation procedure.</documentation>
            </annotation>
        </element>
        <!-- ..................................... -->
        <complexType name="ItemDefinitionPropertyType">
            <sequence minOccurs="0">
```

```
                <element ref="swe:ItemDefinition"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="ItemSeriesDefinitionType">
            <annotation>
                <documentation>Description of a series of scalar properties with a common representation and
scale.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:ItemDefinitionType">
                    <attribute name="recordLength" type="positiveInteger" use="required">
                        <annotation>
                            <documentation>The number of components in the tuple</documentation>
                        </annotation>
                    </attribute>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="ItemSeriesDefinition" type="swe:ItemSeriesDefinitionType"
substitutionGroup="swe:ItemDefinition">
            <annotation>
                <documentation>Description of a series of scalar properties with a common representation and
scale.</documentation>
            </annotation>
        </element>
        <!-- ..................................... -->
        <complexType name="ItemSeriesDefinitionPropertyType">
            <sequence minOccurs="0">
                <element ref="swe:ItemSeriesDefinition"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <complexType name="RecordDefinitionType">
            <annotation>
                <documentation>A Record Definition is composed from arbitrary base axes, which may be
records.</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:RecordTypeType">
                    <sequence>
                        <element name="field" type="swe:RecordTypePropertyType" maxOccurs="unbounded"/>
                    </sequence>
                    <attribute name="recordLength" type="positiveInteger" use="required">
                        <annotation>
                            <documentation>The number of components in the tuple</documentation>
                        </annotation>
                    </attribute>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="RecordDefinition" type="swe:RecordDefinitionType" substitutionGroup="swe:RecordType">
            <annotation>
                <documentation>A Record Definition is composed from arbitrary base axes, which may be
records.</documentation>
            </annotation>
        </element>
        <!-- ..................................... -->
        <complexType name="RecordDefinitionPropertyType">
            <sequence minOccurs="0">
                <element ref="swe:RecordDefinition"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <!-- === Type designed to allow the specification of simpleContent types in-line === -->
```

```
	<!-- ========================================================================== -->
	<complexType name="RepresentationType">
		<annotation>
			<documentation>this uses components copied from XML Schema to describe the "value-space" in terms
of
			a base type and facets, or a composite such as a union.

		For numeric types this will normally indicate integer, double etc and (optionally) facets
		to describe one or more intervals or a precision.
		For textual types this will normally indicate string, token etc and (optionally) facets
		will indicate a pattern, enumeration, length etc.</documentation>
		</annotation>
		<sequence>
			<element name="SimpleType">
				<complexType>
					<complexContent>
						<extension base="xst:localSimpleType">
							<sequence>
								<group ref="swe:scale"/>
							</sequence>
						</extension>
					</complexContent>
				</complexType>
			</element>
		</sequence>
	</complexType>
	<!-- ......  ...... -->
	<group name="scale">
		<choice>
			<sequence>
				<element ref="gml:unitOfMeasure">
					<annotation>
						<documentation>Use this element to indicate an unit of measure for numeric values on
a ratio scale.</documentation>
					</annotation>
				</element>
				<element name="frame" type="gml:ReferenceType" minOccurs="0">
					<annotation>
						<documentation>Use this element to indicate the description of a reference system for
numeric values on an interval scale.</documentation>
					</annotation>
				</element>
			</sequence>
			<element name="frame" type="gml:ReferenceType">
				<annotation>
					<documentation>Use this element to indicate the description of a reference system for
numeric values on an interval scale.</documentation>
				</annotation>
			</element>
			<element name="classification" type="gml:StringOrRefType">
				<annotation>
					<documentation>Use this element to indicate an informally or externally described
classification scheme for values on an Ordinal or Nominal scale.</documentation>
				</annotation>
			</element>
			<element name="noScale" type="boolean" fixed="true"/>
		</choice>
	</group>
	<!-- ========================================================================== -->
</schema>
```

5.7 simpleTypeDerivation.xsd

The W3C XML “Schema for Schemas” is used as the basis for describing the representation of simple content types within ItemDefinition instances. However, due to difficulties in validation resulting from importing schema components that are already

assumed to exist by the XML processors, these components have been declared in a new namespace for the present purposes.

Listing 23. simpleTypeDerivation.xsd

```
<?xml version="1.0"?>
<!-- Derived from XML Schema schema for XML Schemas: Part 2: Datatypes -->
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:st="http://www.opengis.net/swe/st"
xmlns:hfp="http://www.w3.org/2001/XMLSchema-hasFacetAndProperty"
targetNamespace="http://www.opengis.net/swe/st" elementFormDefault="qualified" xml:lang="en">
        <xs:annotation>
                <xs:documentation>
This schema is based on the W3C XML Schema schema for XML Schemas: Part 2: Datatypes

The definitions of the "magic" built-in datatypes have been removed
The components for defining derived simpleTypes are retained, but defined in a new namespace.
    </xs:documentation>
        </xs:annotation>
        <!-- these next six components from XMLSchema.xsd -->
        <xs:import namespace="http://www.w3.org/XML/1998/namespace"
schemaLocation="http://www.w3.org/2001/xml.xsd">
                <xs:annotation>
                        <xs:documentation>
      Get access to the xml: attribute groups for xml:lang
      as declared on 'schema' and 'documentation' below
    </xs:documentation>
                </xs:annotation>
        </xs:import>
        <xs:complexType name="openAttrs">
                <xs:annotation>
                        <xs:documentation>
      This type is extended by almost all schema types
      to allow attributes from other namespaces to be
      added to user schemas.
    </xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                        <xs:restriction base="xs:anyType">
                                <xs:anyAttribute namespace="##other" processContents="lax"/>
                        </xs:restriction>
                </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="annotated">
                <xs:annotation>
                        <xs:documentation>
      This type is extended by all types which allow annotation
      other than &lt;schema&gt; itself
    </xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                        <xs:extension base="st:openAttrs">
                                <xs:sequence>
                                        <xs:element ref="st:annotation" minOccurs="0"/>
                                </xs:sequence>
                                <xs:attribute name="id" type="xs:ID"/>
                        </xs:extension>
                </xs:complexContent>
        </xs:complexType>
        <xs:element name="appinfo" id="appinfo">
                <xs:annotation>
                        <xs:documentation source="./#element-appinfo"/>
                </xs:annotation>
                <xs:complexType mixed="true">
                        <xs:sequence minOccurs="0" maxOccurs="unbounded">
                                <xs:any processContents="lax"/>
                        </xs:sequence>
                        <xs:attribute name="source" type="xs:anyURI"/>
                </xs:complexType>
```

```
    </xs:element>
    <xs:element name="documentation" id="documentation">
        <xs:annotation>
            <xs:documentation source="./#element-documentation"/>
        </xs:annotation>
        <xs:complexType mixed="true">
            <xs:sequence minOccurs="0" maxOccurs="unbounded">
                <xs:any processContents="lax"/>
            </xs:sequence>
            <xs:attribute name="source" type="xs:anyURI"/>
            <xs:attribute ref="xml:lang"/>
        </xs:complexType>
    </xs:element>
    <xs:element name="annotation" id="annotation">
        <xs:annotation>
            <xs:documentation source="./#element-annotation"/>
        </xs:annotation>
        <xs:complexType>
            <xs:complexContent>
                <xs:extension base="st:openAttrs">
                    <xs:choice minOccurs="0" maxOccurs="unbounded">
                        <xs:element ref="st:appinfo"/>
                        <xs:element ref="st:documentation"/>
                    </xs:choice>
                    <xs:attribute name="id" type="xs:ID"/>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
    </xs:element>
    <!-- from here to end of document from datatypes.xsd -->
    <xs:simpleType name="derivationControl">
        <xs:annotation>
            <xs:documentation>
A utility type, not for public use</xs:documentation>
        </xs:annotation>
        <xs:restriction base="xs:NMTOKEN">
            <xs:enumeration value="substitution"/>
            <xs:enumeration value="extension"/>
            <xs:enumeration value="restriction"/>
            <xs:enumeration value="list"/>
            <xs:enumeration value="union"/>
        </xs:restriction>
    </xs:simpleType>
    <xs:group name="simpleDerivation">
        <xs:choice>
            <xs:element ref="st:restriction"/>
            <xs:element ref="st:list"/>
            <xs:element ref="st:union"/>
        </xs:choice>
    </xs:group>
    <xs:simpleType name="simpleDerivationSet">
        <xs:annotation>
            <xs:documentation>
#all or (possibly empty) subset of {restriction, union, list}
</xs:documentation>
            <xs:documentation>
A utility type, not for public use</xs:documentation>
        </xs:annotation>
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:token">
                    <xs:enumeration value="#all"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="st:derivationControl">
                    <xs:enumeration value="list"/>
                    <xs:enumeration value="union"/>
                    <xs:enumeration value="restriction"/>
                </xs:restriction>
            </xs:simpleType>
```

```
            </xs:union>
        </xs:simpleType>
        <xs:complexType name="simpleType" abstract="true">
            <xs:complexContent>
                <xs:extension base="st:annotated">
                    <xs:group ref="st:simpleDerivation"/>
                    <xs:attribute name="final" type="st:simpleDerivationSet"/>
                    <xs:attribute name="name" type="xs:NCName">
                        <xs:annotation>
                            <xs:documentation>
      Can be restricted to required or forbidden
    </xs:documentation>
                        </xs:annotation>
                    </xs:attribute>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="topLevelSimpleType">
            <xs:complexContent>
                <xs:restriction base="st:simpleType">
                    <xs:sequence>
                        <xs:element ref="st:annotation" minOccurs="0"/>
                        <xs:group ref="st:simpleDerivation"/>
                    </xs:sequence>
                    <xs:attribute name="name" type="xs:NCName" use="required">
                        <xs:annotation>
                            <xs:documentation>
      Required at the top level
    </xs:documentation>
                        </xs:annotation>
                    </xs:attribute>
                </xs:restriction>
            </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="localSimpleType">
            <xs:complexContent>
                <xs:restriction base="st:simpleType">
                    <xs:sequence>
                        <xs:element ref="st:annotation" minOccurs="0"/>
                        <xs:group ref="st:simpleDerivation"/>
                    </xs:sequence>
                    <xs:attribute name="name" type="xs:NCName" use="prohibited">
                        <xs:annotation>
                            <xs:documentation>
      Forbidden when nested
    </xs:documentation>
                        </xs:annotation>
                    </xs:attribute>
                    <xs:attribute name="final" type="st:simpleDerivationSet" use="prohibited"/>
                </xs:restriction>
            </xs:complexContent>
        </xs:complexType>
        <xs:element name="simpleType" type="st:topLevelSimpleType" id="simpleType">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
simpleType"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:group name="facets">
            <xs:annotation>
                <xs:documentation>
    We should use a substitution group for facets, but
    that's ruled out because it would allow users to
    add their own, which we're not ready for yet.
  </xs:documentation>
            </xs:annotation>
            <xs:choice>
                <xs:element ref="st:minExclusive"/>
                <xs:element ref="st:minInclusive"/>
                <xs:element ref="st:maxExclusive"/>
                <xs:element ref="st:maxInclusive"/>
```

```
                <xs:element ref="st:totalDigits"/>
                <xs:element ref="st:fractionDigits"/>
                <xs:element ref="st:length"/>
                <xs:element ref="st:minLength"/>
                <xs:element ref="st:maxLength"/>
                <xs:element ref="st:enumeration"/>
                <xs:element ref="st:whiteSpace"/>
                <xs:element ref="st:pattern"/>
            </xs:choice>
        </xs:group>
        <xs:group name="simpleRestrictionModel">
            <xs:sequence>
                <xs:element name="simpleType" type="st:localSimpleType" minOccurs="0"/>
                <xs:group ref="st:facets" minOccurs="0" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:group>
        <xs:element name="restriction" id="restriction">
            <xs:complexType>
                <xs:annotation>
                    <xs:documentation>source="./XML Schema Part 2 Datatypes.htm#element-restriction"
        base attribute and simpleType child are mutually
        exclusive, but one or other is required
       </xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                    <xs:extension base="st:annotated">
                        <xs:group ref="st:simpleRestrictionModel"/>
                        <xs:attribute name="base" type="xs:QName" use="optional"/>
                    </xs:extension>
                </xs:complexContent>
            </xs:complexType>
        </xs:element>
        <xs:element name="list" id="list">
            <xs:complexType>
                <xs:annotation>
                    <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-list"
        itemType attribute and simpleType child are mutually
        exclusive, but one or other is required
       </xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                    <xs:extension base="st:annotated">
                        <xs:sequence>
                            <xs:element name="simpleType" type="st:localSimpleType" minOccurs="0"/>
                        </xs:sequence>
                        <xs:attribute name="itemType" type="xs:QName" use="optional"/>
                    </xs:extension>
                </xs:complexContent>
            </xs:complexType>
        </xs:element>
        <xs:element name="union" id="union">
            <xs:complexType>
                <xs:annotation>
                    <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-union"
        memberTypes attribute must be non-empty or there must be
        at least one simpleType child
       </xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                    <xs:extension base="st:annotated">
                        <xs:sequence>
                            <xs:element name="simpleType" type="st:localSimpleType" minOccurs="0"
maxOccurs="unbounded"/>
                        </xs:sequence>
                        <xs:attribute name="memberTypes" use="optional">
                            <xs:simpleType>
                                <xs:list itemType="xs:QName"/>
                            </xs:simpleType>
                        </xs:attribute>
                    </xs:extension>
                </xs:complexContent>
```

```
            </xs:complexType>
        </xs:element>
        <xs:complexType name="facet">
            <xs:complexContent>
                <xs:extension base="st:annotated">
                    <xs:attribute name="value" use="required"/>
                    <xs:attribute name="fixed" type="xs:boolean" use="optional" default="false"/>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="noFixedFacet">
            <xs:complexContent>
                <xs:restriction base="st:facet">
                    <xs:sequence>
                        <xs:element ref="st:annotation" minOccurs="0"/>
                    </xs:sequence>
                    <xs:attribute name="fixed" type="xs:boolean" use="prohibited"/>
                </xs:restriction>
            </xs:complexContent>
        </xs:complexType>
        <xs:element name="minExclusive" type="st:facet" id="minExclusive">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
minExclusive"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="minInclusive" type="st:facet" id="minInclusive">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
minInclusive"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="maxExclusive" type="st:facet" id="maxExclusive">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
maxExclusive"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="maxInclusive" type="st:facet" id="maxInclusive">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
maxInclusive"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:complexType name="numFacet">
            <xs:complexContent>
                <xs:restriction base="st:facet">
                    <xs:sequence>
                        <xs:element ref="st:annotation" minOccurs="0"/>
                    </xs:sequence>
                    <xs:attribute name="value" type="xs:nonNegativeInteger" use="required"/>
                </xs:restriction>
            </xs:complexContent>
        </xs:complexType>
        <xs:element name="totalDigits" id="totalDigits">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
totalDigits"</xs:documentation>
            </xs:annotation>
            <xs:complexType>
                <xs:complexContent>
                    <xs:restriction base="st:numFacet">
                        <xs:sequence>
                            <xs:element ref="st:annotation" minOccurs="0"/>
                        </xs:sequence>
                        <xs:attribute name="value" type="xs:positiveInteger" use="required"/>
                    </xs:restriction>
                </xs:complexContent>
            </xs:complexType>
        </xs:element>
        <xs:element name="fractionDigits" type="st:numFacet" id="fractionDigits">
```

```
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
fractionDigits"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="length" type="st:numFacet" id="length">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-length"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="minLength" type="st:numFacet" id="minLength">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
minLength"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="maxLength" type="st:numFacet" id="maxLength">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
maxLength"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="enumeration" type="st:noFixedFacet" id="enumeration">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
enumeration"</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="whiteSpace" id="whiteSpace">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
whiteSpace"</xs:documentation>
            </xs:annotation>
            <xs:complexType>
                <xs:complexContent>
                    <xs:restriction base="st:facet">
                        <xs:sequence>
                            <xs:element ref="st:annotation" minOccurs="0"/>
                        </xs:sequence>
                        <xs:attribute name="value" use="required">
                            <xs:simpleType>
                                <xs:restriction base="xs:NMTOKEN">
                                    <xs:enumeration value="preserve"/>
                                    <xs:enumeration value="replace"/>
                                    <xs:enumeration value="collapse"/>
                                </xs:restriction>
                            </xs:simpleType>
                        </xs:attribute>
                    </xs:restriction>
                </xs:complexContent>
            </xs:complexType>
        </xs:element>
        <xs:element name="pattern" type="st:noFixedFacet" id="pattern">
            <xs:annotation>
                <xs:documentation> source="./XML Schema Part 2 Datatypes.htm#element-
pattern"</xs:documentation>
            </xs:annotation>
        </xs:element>
</xs:schema>
```

5.8 phenomenon.xsd

This document provides an implementation of the Phenomenon model described in ANNEX C clause 3 and shown in Figure 10.

Listing 24. phenomenon.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:swe="http://www.opengis.net/swe" xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml"
      targetNamespace="http://www.opengis.net/swe" elementFormDefault="qualified" attributeFormDefault="unqualified"
      version="pre-release">
       <annotation>
            <documentation>phenomenon.xsd

A GML conformant schema
for definitions of phenomena, per Annex C of OM specification

Copyright (c) 2006 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
       </annotation>
       <!-- ============================================================================ -->
       <!-- bring in other schemas -->
       <import namespace="http://www.opengis.net/gml" schemaLocation="../../../../gml/trunk/gml/3.2.0/gml/gml.xsd"/>
       <include schemaLocation="./SWE_basicTypes.xsd"/>
       <!-- ============================================================================ -->
       <complexType name="PhenomenonType">
            <annotation>
                 <documentation>Basic Phenomenon definition, and head of substitution group of specialized
phenomenon defs.
                 gml:description may be used for a more extensive description of the semantics, with a link to a definitive
version (if available).
                 gml:name should be used for the "short name" or label.</documentation>
            </annotation>
            <complexContent>
                 <extension base="gml:DefinitionType"/>
            </complexContent>
       </complexType>
       <!-- ......... -->
       <element name="Phenomenon" type="swe:PhenomenonType" substitutionGroup="gml:Definition">
            <annotation>
                 <documentation>Basic Phenomenon definition, and head of substitution group of specialized
phenomenon defs.
                 gml:description may be used for a more extensive description of the semantics, with a link to a definitive
version (if available).
                 gml:name should be used for the "short name" or label.</documentation>
            </annotation>
       </element>
       <!-- ......... -->
       <complexType name="PhenomenonPropertyType">
            <sequence minOccurs="0">
                 <element ref="swe:Phenomenon"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
       </complexType>
       <!-- ============================================================================ -->
       <complexType name="ConstrainedPhenomenonType">
            <annotation>
                 <documentation>A scalar Phenomenon is defined by adding constraints to an existing
property.</documentation>
            </annotation>
            <complexContent>
                 <extension base="swe:PhenomenonType">
                      <sequence>
                           <element name="base" type="swe:PhenomenonPropertyType">
                                <annotation>
                                     <documentation>Property that forms the basis for generating a set of more
refined Phenomena; e.g. Chemical Composition, Radiance</documentation>
                                </annotation>
                           </element>
                           <element name="otherConstraint" type="string" minOccurs="0" maxOccurs="unbounded">
                                <annotation>
                                     <documentation>Constraints that cannot be expressed as values of an
orthogonal/helper phenomenon</documentation>
                                </annotation>
                           </element>
```

```
                        <element name="singleConstraint" type="swe:TypedValuePropertyType" minOccurs="0"
maxOccurs="unbounded">
                            <annotation>
                                <documentation>Constraint expressed as a value or range of an
orthogonal/helper phenomenon</documentation>
                            </annotation>
                        </element>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="ConstrainedPhenomenon" type="swe:ConstrainedPhenomenonType"
substitutionGroup="swe:Phenomenon">
            <annotation>
                <documentation>Description of a scalar Phenomenon defined by adding constraints to a property
previously defined elsewhere.</documentation>
            </annotation>
        </element>
        <!-- ========================================================================== -->
        <!-- ========================================================================== -->
        <complexType name="CompoundPhenomenonType" abstract="true">
            <annotation>
                <documentation>Description of a set of Phenomena.
          CompoundPhenomenon is the abstract head of a substitution group of specialized compound
phenomena</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:PhenomenonType">
                    <attribute name="dimension" type="positiveInteger" use="required">
                        <annotation>
                            <documentation>The number of components in the tuple</documentation>
                        </annotation>
                    </attribute>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="CompoundPhenomenon" type="swe:CompoundPhenomenonType" abstract="true"
substitutionGroup="swe:Phenomenon">
            <annotation>
                <documentation>Description of a set of Phenomena.
          CompoundPhenomenon is the abstract head of a substitution group of specialized compound
phenomena</documentation>
            </annotation>
        </element>
        <!-- ========================================================================== -->
        <complexType name="CompositePhenomenonType">
            <annotation>
                <documentation>A Phenomenon defined as a set of explicitly enumerated components which may or
may not be related to one another</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CompoundPhenomenonType">
                    <sequence>
                        <element name="base" type="swe:PhenomenonPropertyType" minOccurs="0">
                            <annotation>
                                <documentation>Optional phenomenon that forms the basis for generating more
specialized composite Phenomenon by adding more components</documentation>
                            </annotation>
                        </element>
                        <element name="component" type="swe:PhenomenonPropertyType"
maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="CompositePhenomenon" type="swe:CompositePhenomenonType"
substitutionGroup="swe:CompoundPhenomenon">
            <annotation>
```

```
                <documentation>A Phenomenon defined as a set of explicitly enumerated components which may or
may not be related to one another</documentation>
            </annotation>
        </element>
        <!-- ================================================================== -->
        <complexType name="PhenomenonSeriesType">
            <annotation>
                <documentation>A phenomenon defined as a base property convolved with a set of constraints
    The set of constraints may be either
    * an explicit set of soft-typed measures, intervals and categories
    * one or more lists of soft-typed measures, intervals and categories
    * one or more sequences of soft-typed measures and intervals</documentation>
            </annotation>
            <complexContent>
                <extension base="swe:CompoundPhenomenonType">
                    <sequence>
                        <element name="base" type="swe:PhenomenonPropertyType">
                            <annotation>
                                <documentation>Phenomenon that forms the basis for generating a set of more
refined Phenomena; e.g. Chemical Composition, Radiance</documentation>
                            </annotation>
                        </element>
                        <element name="constraintList" type="swe:TypedValueListPropertyType"
maxOccurs="unbounded">
                            <annotation>
                                <documentation>A set of values of some secondary property that constraints the
basePhenomenon to generate a Phenomenon set.
                                    If more than one set of constraints are possible, then these are applied
simultaneously to generate</documentation>
                            </annotation>
                        </element>
                        <element name="otherConstraint" type="string" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ..................................... -->
        <element name="PhenomenonSeries" type="swe:PhenomenonSeriesType"
substitutionGroup="swe:CompoundPhenomenon">
            <annotation>
                <documentation>A phenomenon defined as a base property convolved with a set of constraints
    The set of constraints may be either
    * an explicit set of soft-typed measures, intervals and categories
    * one or more lists of soft-typed measures, intervals and categories
    * one or more sequences of soft-typed measures and intervals</documentation>
            </annotation>
        </element>
        <!-- ================================================================== -->
        <!-- ================================================================== -->
</schema>
```

5.9 swe.xsd

This stub schema document collects all the SWE Common components used in the O&M schema. Use of this document in for external references to the SWE Common package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 25. swe.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" targetNamespace="http://www.opengis.net/swe"
elementFormDefault="qualified" attributeFormDefault="unqualified">
```

```
	<xs:annotation>
		<xs:documentation>Stub schema for swe</xs:documentation>
	</xs:annotation>
	<!--========================-->
	<xs:include schemaLocation="./discreteCoverage.xsd"/> <!-- transitively includes temporal aggregates and
aggregates-->
	<xs:include schemaLocation="./recordType.xsd"/>  <!-- transitively includes phenomenon -->
	<xs:include schemaLocation="./positionData.xsd"/> <!-- transitively includes parameters and encoding -->
</xs:schema>
```

ANNEX E
(informative)

XML implementation - examples

1 Introduction

The details of the GML implementation are most easily explored using instance examples. The GML implementation is an explicit mapping from the model, largely using names from the model as element and attribute names, so inspection of sample data is an effective way to assess the effectiveness of the model in capturing the required information. In this clause we present a graduated series of examples to illustrate the model and encoding.

Observations may have many result types. It may also be convenient to provide the result value out-of-band. The details of how the result is encoded is not important to the model, though practical interoperability in data transfer is best served by agreement on the form.

In several of the examples below alternative encodings with different advantages are shown for “complex” results. These include:

1. a compact record contained within a single XML element, composed of a list of records each corresponding to a set of parameter values whose structure is then repeated. The syntax is taken from SensorML [SensorML]. Item and record separators are explicit, and may be changed. This microformat requires a specific writer and reader to augment standard XML processing

2. a record or discrete coverage in which the items are encoded in separate XML elements. This is verbose, but has the advantage of using the basic XML structuring components that are accessible in all XML processing environments. This makes applications for both writing and reading easier to implement.

In all cases, the semantics of the record structure are indicated separately, in the recordDefinition.

2 Simple Observations with scalar results

2.1 Measurements

The document shown in Listing 26 describes a simple observation to determine the mass of a specific banana.

Listing 26. observation1.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="obsTest1"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
        xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Observation test instance</gml:description>
    <gml:name>Observation test 1</gml:name>
    <om:time>
        <gml:TimeInstant gml:id="ot1t">
            <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
        </gml:TimeInstant>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:OGC:scales"/>
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:mass"/>
    <om:featureOfInterest xlink:href="http://some.interested.org/subiMarkets/vegetables/banana1"/>
    <om:result xsi:type="gml:MeasureType" uom="urn:x-ogc:def:uom:OGC:kg">0.28</om:result>
</om:Observation>
```

The value of the procedure (“scales”), the observedProperty (“mass”), and the featureOfInterest (a banana) are all given as references to external objects, using xlink:href attributes following the standard GML pattern. These references are all given as URIs: the first two use the (proposed) OGC URN scheme [OGC 06-023r1], and the third is a (notional) URL.

The type of the result is indicated in the instance using the standard xsi:type attribute [W3C XML Schema]. In this example it is gml:MeasureType, so the required **uom** attribute is also present. The value of the uom is also given as a URN according to the OGC scheme.

NOTE: In GML 3.2/ISO DIS 19136 the type of the uom attribute is extended to allow unit symbols from the UCUM scheme, allowing the more familiar short symbols like “kg” to appear instead of a URI.

The document shown in Listing 27 describes the same observation using the specialized observation type Measurement.

Listing 27. observation1m.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Measurement gml:id="obsTest1m"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
        xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Observation test instance</gml:description>
    <gml:name>Observation test 1m</gml:name>
    <om:time>
        <gml:TimeInstant gml:id="ot1t">
            <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
        </gml:TimeInstant>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:OGC:scales"/>
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:mass"/>
    <om:featureOfInterest xlink:href="http://some.interested.org/subiMarkets/vegetables/banana"/>
    <om:result uom="urn:x-ogc:def:uom:OGC:kg" qualifier="greaterThanOrEquals">0.28</om:result>
</om:Measurement>
```

The result type is fixed so the xsi:type attribute is not needed. An additional variation is that the optional **qualifier** attribute appears, and here indicates that the value given is a lower bound estimate rather than exact.

2.2 Category observations

The document shown in Listing 28 describes a simple observation to determine the species of an item of market produce.

Listing 28. observation2.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="obsTest2"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:sa="http://www.opengeospatial.net/sampling/0.0"
xmlns:swe="http://www.opengis.net/swe"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd http://www.opengeospatial.net/sampling/0.0
../../../sampling/current/sampling.xsd">
    <gml:description>Observation test instance</gml:description>
    <gml:name>Observation test 2</gml:name>
    <om:time>
        <gml:TimeInstant gml:id="ot2t">
            <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
        </gml:TimeInstant>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Observer:SEEGrid:cox075"/>
    <!-- a notional URN identifying an informal procedure ... -->
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Species"/>
    <!-- a notional URN identifying the observed property -->
    <om:featureOfInterest>
        <sa:Station gml:id="ot2s">
            <gml:name>8903</gml:name>
            <sa:position>
                <gml:Point gml:id="ot2p">
                    <gml:pos srsName="urn:x-ogc:def:crs:EPSG:6.3:62836405">-30.7025065
134.1997256</gml:pos>
                </gml:Point>
            </sa:position>
        </sa:Station>
    </om:featureOfInterest>
    <om:result xsi:type="swe:ScopedNameType"
codeSpace="http://en.wikipedia.org/wiki/List_of_fruits">Banana</om:result>
    <!-- The XML Schema type of the result is indicated using the value of the xsi:type attribute -->
</om:Observation>
```

The value of the procedure (a human observer), and observedProperty (“species”) are given as references, following the standard GML pattern using xlink:href attributes. These references are all given as URIs, using the OGC URN scheme. The featureOfInterest in this example is an observation station, which is a simple point-located feature used for observations (see sub-clause 7.3).

The type of the result is indicated in the instance using the standard xsi:type attribute [W3C XML Schema]. In this example it is swe:ScopedNameType, so the required **codeSpace** attribute is also present. The value of the codeSpace is a reference to a vocabulary from which the value of the result was taken.

The document shown in Listing 29 describes the same observation using the specialized observation type CategoryObservation. The result type is fixed so the xsi:type attribute is not needed.

Listing 29. observation2c.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:CategoryObservation gml:id="obsTest2"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation test instance</gml:description>
        <gml:name>Observation test 2</gml:name>
        <om:time>
                <gml:TimeInstant gml:id="ot2t">
                        <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
                </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Observer:SEEGrid:cox075"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Species"/>
        <om:featureOfInterest xlink:href="foi.xml#ot2s"/>
        <om:result codeSpace="http://en.wikipedia.org/wiki/List_of_fruits">Banana</om:result>
</om:CategoryObservation>
```

2.3 Observation of a complex property

The document shown in Listing 30 describes an observation of the shape of a banana.

Listing 30. observation2shape.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="shapeTest2"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation test instance</gml:description>
        <gml:name>Shape observation test</gml:name>
        <om:time>
                <gml:TimeInstant gml:id="ot2t">
                        <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
                </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Observer:SEEGrid:cox075"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Shape"/>
        <om:featureOfInterest xlink:href="foi.xml#ot2s"/>
        <om:result>
                <gml:Solid gml:id="bs">
                        <gml:description>An explicit description of a solid.</gml:description>
                        <gml:exterior>
                                <gml:Surface gml:id="bss"> ... </gml:Surface>
                        </gml:exterior>
                </gml:Solid>
        </om:result>
</om:Observation>
```

Most of the document follows the previous examples. However, the observed property is “Shape” and the result is expressed as a gml:Solid (details suppressed for brevity). This example illustrates the benefit of being able to use any available type in the result of a generic observation. Since the result is an XML encoded data structure, the result is contained a sub-element whose name is explicit, so no xsi:type attribute is required.

3 Observations pointing to results provided out-of-band

These examples shows basic observations where the result is provided external to the observation instance document, and identified using a URI.

The document shown in Listing 31 describes an observation of Relative Humidity at an observation station.

Listing 31. Pointer1.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="OPTest1"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation instance with remote result</gml:description>
        <gml:name>Observation Pointer 1</gml:name>
        <om:time>
                <gml:TimePeriod gml:id="op1t">
                        <gml:beginPosition>2005-01-11T17:22:25.00</gml:beginPosition>
                        <gml:endPosition>2005-01-11T18:22:25.00</gml:endPosition>
                </gml:TimePeriod>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:3eti:abc45"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:RelativeHumidity"/>
        <om:featureOfInterest xlink:href="http://my.modest.org/wfs%26request=getFeature%26id=789002"
xlink:role="urn:seegrid:definition:featuretype:station"/>
        <om:result xlink:href="http://my.modest.org/results%3f798002%26property=RH" xlink:role="application/xmpp"
xsi:type="gml:ReferenceType"/>
</om:Observation>
```

The observation event time is a **gml:TimePeriod**, so the result is likely to be a time-series, potentially with many values. For this reason, it may be convenient to provide the result as a data stream out-of-band from the document describing the observation.

The values of the procedure (an instrument), observedProperty (“Relative Humidity”), and feature of interest (an observation station) are given as references, following the standard GML pattern using xlink:href attributes. These references are all given as URIs: the first two use the OGC URN scheme; the featureOfInterest in this example is obtained via a service call to a WFS service.

The type of the result in this example is gml:ReferenceType. The result value is indicated by the value of the xlink:href attribute. The value of the (optional) xlink:role attribute describes the nature of the external resource, here given as a MIME type.

The document shown in Listing 32 describes an observation of “Stress” in a shallow borehole.

Listing 32. Pointer2.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="OPTest2"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation instance with remote result</gml:description>
        <gml:name>Observation Pointer 2</gml:name>
        <om:time>
                <gml:TimePeriod gml:id="op1t">
                        <gml:beginPosition>2005-01-11T17:22:25.00</gml:beginPosition>
                        <gml:endPosition>2005-01-11T18:22:25.00</gml:endPosition>
                </gml:TimePeriod>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:SEEGrid:overcoring"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:SEEGrid:stress"/>
        <om:featureOfInterest xlink:href="http://some.datasupplying.org/wfs%26request=getFeature%26id=789002"
xlink:role="urn:seegrid:definition:featuretype:borehole"/>
        <om:result xlink:href="http://some.datasupplying.org/results%3f798002%26property=stress"
xlink:role="application/xml" xsi:type="gml:ReferenceType"/>
</om:Observation>
```

The type of the result in this example is gml: ReferenceType. The result value is indicated by the value of the xlink:href attribute, and the mimeType is indicated using the xlink:role attribute.

4 Compound observations

4.1 Observation Collection

The document shown in Listing 33 describes a collection of two observations.

Listing 33. Collection1.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:ObservationCollection gml:id="coll1"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Collection of observations</gml:description>
        <gml:name>Observation Collection 1</gml:name>
        <om:time>
                <gml:TimePeriod gml:id="op1t">
                        <gml:beginPosition>2005-01-11T17:22:25.00</gml:beginPosition>
                        <gml:endPosition>2005-01-11T17:24:25.00</gml:endPosition>
                </gml:TimePeriod>
        </om:time>
        <om:member>
                <om:Observation gml:id="o1">
                        <om:time>
                                <gml:TimeInstant gml:id="ot1t">
```

```
                        <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
                    </gml:TimeInstant>
                </om:time>
                <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:OGC:scales"/>
                <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:mass"/>
                <om:featureOfInterest xlink:href="http://some.interested.org/vegetables/subiMarkets/banana1"/>
                <om:result xsi:type="gml:MeasureType" uom="urn:x-ogc:def:uom:OGC:kg">0.28</om:result>
            </om:Observation>
        </om:member>
        <om:member>
            <om:Observation gml:id="o2">
                <om:time>
                    <gml:TimeInstant gml:id="ot2t">
                        <gml:timePosition>2005-01-11T17:24:25.00</gml:timePosition>
                    </gml:TimeInstant>
                </om:time>
                <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:OGC:scales"/>
                <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:mass"/>
                <om:featureOfInterest xlink:href="http://some.interested.org/vegetables/subiMarkets/banana2"/>
                <om:result xsi:type="gml:MeasureType" uom="urn:x-ogc:def:uom:OGC:kg">0.27</om:result>
            </om:Observation>
        </om:member>
</om:ObservationCollection>
```

The member observations should be consistent with the values or ranges of time and location of the ObservationCollection, but there are no other constraints on the relationships between them.

4.2 Compound observed property

In these examples, the result of the observation is a complex value because the observed property (weather) requires multiple components.

In Listing 34 the result is given as a swe:Record (**Error! Reference source not found.**), which separates the components into XML elements.

Listing 34. complexObservation3.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="COTest3" xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:swe="http://www.opengis.net/swe" xmlns:xst="http://www.opengis.net/swe/st"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xlink="http://www.w3.org/1999/xlink"
            xmlns:gml="http://www.opengis.net/gml" xsi:schemaLocation="http://www.opengeospatial.net/om/0.0
../om.xsd">
        <gml:description>Complex Observation test instance</gml:description>
        <gml:name>Complex Observation test 3</gml:name>
        <om:time>
            <gml:TimeInstant gml:id="ot1t">
                <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
            </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:SEEGrid:weatherStation1"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:SEEGrid:weather1"/>
        <om:featureOfInterest xlink:href="http://www.ga.gov.au/bin/gazd01?rec=293604" xlink:role="urn:x-
seegrid:definition:featuretype:locality"/>
        <om:resultDefinition xlink:href="weatherRecordDefinition.xml"/>
        <om:result>
            <swe:Record>
                <swe:field><swe:Item>35.1</swe:Item></swe:field>
                <swe:field><swe:Item>6.5</swe:Item></swe:field>
                <swe:field><swe:Item>085.0</swe:Item></swe:field>
                <swe:field><swe:Item>950.</swe:Item></swe:field>
```

```
                <swe:field><swe:Item>32.0</swe:Item></swe:field>
                <swe:field><swe:Item>clear</swe:Item></swe:field>
            </swe:Record>
        </om:result>
</om:Observation>
```

The feature of interest are indicated through a link to an entry in an online gazetteer. The observedProperty is given as a link to an entry in a dictionary of phenomenon definitions, the content of which is shown in Listing 35. The resultDefinition gives a link to a RecordDefinition, shown in Listing 36.

The document fragment shown in Listing 35 shows a phenomenon description composed of six elements, given as links to definitions identified by URN. The base phenomenon ("Weather") allows this specialized definition ("weather1") to be related to its parent. The parent phenomenon may be used by some interfaces to allow discovery of related offerings.

Listing 35. Phenonena.xml#weather1

```
<swe:CompositePhenomenon gml:id="weather1" dimension="6">
        <gml:name codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)"
                        >urn:x-ogc:def:phenomenon:SEEGrid:weather1</gml:name>
        <swe:base xlink:href="urn:x-ogc:def:phenomenon:OGC:Weather"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:AirTemperature"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:WindSpeed"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:WindDirection"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:AtmosphericPressure"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:RelativeHumidity"/>
        <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:Visibility"/>
</swe:CompositePhenomenon>
```

The document fragment shown in Listing 36 shows a record schema that defines the structure of the record in the observation result in Listing 34.

Listing 36. weatherRecordDefinition.xml

```
<?xml version="1.0"?>
<swe:RecordDefinition gml:id="weather1" recordLength="6" xmlns:xst="http://www.opengis.net/swe/st"
                xmlns:swe="http://www.opengis.net/swe" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
                xsi:schemaLocation="http://www.opengis.net/swe ../recordType.xsd">
        <gml:identifier codeSpace="http://somegeneric.org">W1</gml:identifier>
        <gml:name>Weather 1</gml:name>
        <swe:field>
                <swe:FieldDefinition gml:id="at1">
                        <gml:identifier codeSpace="http://somegeneric.org">AT</gml:identifier>
                        <gml:name>Air Temperature</gml:name>
                        <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:AirTemperature"/>
                        <swe:representation>
                                <swe:SimpleType>
                                        <xst:restriction base="xst:decimal"/>
                                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:degC"/>
                                </swe:SimpleType>
                        </swe:representation>
                </swe:FieldDefinition>
        </swe:field>
        <swe:field>
                <swe:FieldDefinition gml:id="ws1">
```

```
                <gml:identifier codeSpace="http://somegeneric.org">WS</gml:identifier>
                <gml:name>Wind Speed</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:WindSpeed"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:decimal">
                            <xst:minInclusive value="0.0"/>
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:m_s"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition>
        </swe:field>
        <swe:field>
            <swe:FieldDefinition gml:id="wd1">
                <gml:identifier codeSpace="http://somegeneric.org">WD</gml:identifier>
                <gml:name>Wind Direction</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:WindDirection"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:decimal">
                            <xst:minInclusive value="0.0"/>
                            <xst:maxExclusive value="360.0"/>
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:deg"/>
                        <swe:frame xlink:href="http://sweet.jpl.nasa.gov/ontology/space.owl#North"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition>
        </swe:field>
        <swe:field>
            <swe:FieldDefinition gml:id="ap1">
                <gml:identifier codeSpace="http://somegeneric.org">AP</gml:identifier>
                <gml:name>Atmospheric Pressure</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:AtmosphericPressure"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:decimal">
                            <xst:minInclusive value="0.0"/>
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:hPa"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition>
        </swe:field>
        <swe:field>
            <swe:FieldDefinition gml:id="rh1">
                <gml:identifier codeSpace="http://somegeneric.org">RH</gml:identifier>
                <gml:name>Relative Humidity</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:RelativeHumidity"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:decimal">
                            <xst:minInclusive value="0.0"/>
                            <xst:maxExclusive value="100.0"/>
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:percent"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition>
        </swe:field>
        <swe:field>
            <swe:FieldDefinition gml:id="vi1">
                <gml:identifier codeSpace="http://somegeneric.org">VI</gml:identifier>
                <gml:name>Visibility</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:Visibility"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:string"/>
                        <swe:classification xlink:href="urn:x-seegrid:definition:vocabulary:visibility"/>
                    </swe:SimpleType>
```

```
                </swe:representation>
            </swe:FieldDefinition>
        </swe:field>
</swe:RecordDefinition>
```

In this example the schema is a RecordDefinition composed of six ordered components, each being an ItemDefinition. Each item binds a property definition to its representation. The representation binds an elementary data-type and a reference system, such as units of measure, frame or classification scheme.

The syntax for describing the elementary datatype is taken from the W3C XML Schema representation of “simpleType” definitions, which includes the ability to constrain the value space with *facets* such as length, minimum and maximum values, patterns, encodings etc [W3C XML Schema, Part 2].

The commonObservation version of the encoding mandates use of an inline swe:DataDefinition [SensorML] as the record schema, as an alternative to the (inline or by-reference) swe:RecordDefinition shown in the previous examples. The example shown in Listing 37 is essentially the same as Listing 34 with this change.

Listing 37. commonObservation2.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:CommonObservation gml:id="COMTest3" xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:swe="http://www.opengis.net/swe"
                xmlns:gml="http://www.opengis.net/gml" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:xlink="http://www.w3.org/1999/xlink"
                xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Common Observation test instance</gml:description>
        <gml:name>Commmon Observation test 2</gml:name>
        <om:time>
                <gml:TimeInstant gml:id="ObservationTime">
                        <gml:timePosition>2005-01-11T17:22:25.00</gml:timePosition>
                </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:SEEGrid:weatherStation1"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:SEEGrid:weather1"/>
        <om:featureOfInterest xlink:href="http://www.ga.gov.au/bin/gazd01?rec=293604"
                        xlink:role="urn:x-seegrid:definition:featuretype:locality"/>
        <om:result>
                <swe:DataGroup>
                        <swe:component name="AirTemperature">
                                <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:AirTemperature">
                                        <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:degC"/>
                                        <swe:value>35.1</swe:value>
                                </swe:Quantity>
                        </swe:component>
                        <swe:component name="WindSpeed">
                                <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:WindSpeed">
                                        <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:m_s"/>
                                        <swe:value>6.5</swe:value>
                                </swe:Quantity>
                        </swe:component>
                        <swe:component name="WindDirection">
                                <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:WindDirectionToNorth">
                                        <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:deg"/>
                                        <swe:value>85.0</swe:value>
                                </swe:Quantity>
                        </swe:component>
                        <swe:component name="AtmosphericPressure">
```

```
                    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:AtmosphericPressure">
                        <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:hPa"/>
                        <swe:value>950.0</swe:value>
                    </swe:Quantity>
                </swe:component>
                <swe:component name="RelativeHumidity">
                    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:RelativeHumidity">
                        <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:percent"/>
                        <swe:value>32.0</swe:value>
                    </swe:Quantity>
                </swe:component>
                <swe:component name="Visibility">
                    <swe:Category definition="urn:x-ogc:def:phenomenon:OGC:Visibility">
                        <swe:value>clear</swe:value>
                    </swe:Category>
                </swe:component>
            </swe:DataGroup>
        </om:result>
</om:CommonObservation>
```

In contrast to the separate RecordDefinition shown in Listing 36, within Listing 37 the definition is embedded within each component, binding semantics (the value of the *definition* attribute) to a representation (the name of the component child element – i.e. *Quantity*, *Category*) and a scale (the value of the *uom* attribute).

4.3 Complex feature of interest

In these examples, the result of the observation varies on a feature of interest that is decomposed into multiple elements.

The documents in this sub-clause describe observations of radiance where the feature of interest is a SiteCollection composed of four Stations. The feature of interest is identified using a link to a description provided external to the document.

In Listing 38 and Listing 39 the observation is encoded using the generic Observation, with the result being a swe:CV_DiscreteCoverage. Listing 38 shows a panchromatic radiance observation. The type of the value element in each geometry-value pair is gml:MeasureType, as indicated using the xsi:type attribute. Listing 39 shows a two-band radiance observation. The type of the value element in each geometry-value pair is a swe:Record, each containing two items whose type is gml:MeasureType.

Listing 38. multiElement1.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="obsTest4"
xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Observation test instance - multi-element featureOfInterest
     * coverage domain == observation featureOfInterest
     * coverage range == observation result
    </gml:description>
    <gml:name>Multi-element 1</gml:name>
    <om:time>
        <gml:TimeInstant gml:id="ots1t">
            <gml:timePosition>2005-06-17</gml:timePosition>
        </gml:TimeInstant>
```

```
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:NASA:xyz345"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Radiance"/>
        <om:featureOfInterest xlink:href="foi.xml#stc1"/>
        <om:result>
                <swe:CV_DiscreteCoverage>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry xlink:href="pixel1"/>
                                        <swe:value xsi:type="gml:MeasureType" uom="uV">10.1</swe:value>
                                </swe:CV_GeometryValuePair>
                        </swe:element>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry xlink:href="pixel2"/>
                                        <swe:value xsi:type="gml:MeasureType" uom="uV">15.7</swe:value>
                                </swe:CV_GeometryValuePair>
                        </swe:element>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry xlink:href="pixel3"/>
                                        <swe:value xsi:type="gml:MeasureType" uom="uV">20.2</swe:value>
                                </swe:CV_GeometryValuePair>
                        </swe:element>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry xlink:href="pixel4"/>
                                        <swe:value xsi:type="gml:MeasureType" uom="uV">27.5</swe:value>
                                </swe:CV_GeometryValuePair>
                        </swe:element>
                </swe:CV_DiscreteCoverage>
        </om:result>
</om:Observation>
```

Listing 39. multiElement2.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="multi2" xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:gco="http://www.isotc211.org/2005/gco"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation test instance - multi-element featureOfInterest
        This is the "observation" view including what is normally encoded as a "coverage"
         * coverage domain == observation featureOfInterest
         * coverage range == observation result</gml:description>
        <gml:name>Multi-element 2</gml:name>
        <om:time>
                <gml:TimeInstant gml:id="ots1t">
                        <gml:timePosition>2005-06-17</gml:timePosition>
                </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:NASA:xyz345"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Radiance"/>
        <om:featureOfInterest xlink:href="foi.xml#stc1"/>
        <om:result>
                <swe:CV_DiscreteCoverage>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry xlink:href="pixel1"/>
                                        <swe:value>
                                                <swe:Record>
                                                        <swe:field><swe:Item xsi:type="gml:MeasureType"
uom="uV">10.1</swe:Item></swe:field>
                                                </swe:Record>
                                        </swe:value>
                                </swe:CV_GeometryValuePair>
                        </swe:element>
```

```
                <swe:element>
                    <swe:CV_GeometryValuePair>
                        <swe:geometry xlink:href="pixel2"/>
                        <swe:value>
                            <swe:Record>
                                <swe:field><swe:Item xsi:type="gml:MeasureType"
uom="uV">15.7</swe:Item></swe:field>
                            </swe:Record>
                        </swe:value>
                    </swe:CV_GeometryValuePair>
                </swe:element>
                <swe:element>
                    <swe:CV_GeometryValuePair>
                        <swe:geometry xlink:href="pixel3"/>
                        <swe:value>
                            <swe:Record>
                                <swe:field><swe:Item xsi:type="gml:MeasureType"
uom="uV">20.2</swe:Item></swe:field>
                            </swe:Record>
                        </swe:value>
                    </swe:CV_GeometryValuePair>
                </swe:element>
                <swe:element>
                    <swe:CV_GeometryValuePair>
                        <swe:geometry xlink:href="pixel4"/>
                        <swe:value>
                            <swe:Record>
                                <swe:field><swe:Item xsi:type="gml:MeasureType"
uom="uV">27.5</swe:Item></swe:field>
                            </swe:Record>
                        </swe:value>
                    </swe:CV_GeometryValuePair>
                </swe:element>
            </swe:CV_DiscreteCoverage>
        </om:result>
</om:Observation>
```

In Listing 40 the information shown in Listing 38 is encoded as a CommonObservation, and the result is an array of 4 StationID/Radiance pairs. Values are given in a sequence following the data structure read from the inside. The sequence in this case will be:
[[StationID Radiance] [StationID Radiance] … x4]

Listing 40. commonObservation3.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:CommonObservation gml:id="COMTest3"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:swe="http://www.opengis.net/swe"
xmlns:gml="http://www.opengis.net/gml"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Common Observation Version of multiElement2.xml</gml:description>
        <gml:name>Multi-element 2</gml:name>
        <om:time>
            <gml:TimeInstant gml:id="ots1t">
                <gml:timePosition>2005-06-17</gml:timePosition>
            </gml:TimeInstant>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:NASA:xyz345"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Radiance"/>
        <om:featureOfInterest xlink:href="foi.xml#stc1"/>
        <om:result>
```

```
            <swe:DataArray>
                <swe:description> array of radiances from 4 stations </swe:description>
                <swe:arraySize> 4 </swe:arraySize>
                <swe:component name="stationRadiances">
                    <swe:DataGroup>
                        <swe:component name="StationID">
                            <swe:Category definition="foi.xml#stc1"/>
                        </swe:component>
                        <swe:component name="Radiance">
                            <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:Radiance">
                                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:uV"/>
                            </swe:Quantity>
                        </swe:component>
                    </swe:DataGroup>
                </swe:component>
                <swe:encoding>
                    <swe:AsciiBlock tokenSeparator=" " tupleSeparator=" " decimalSeparator="."/>
                </swe:encoding>
                <swe:values>st1 10.1 st2 15.7 st3 20.2 st4 27.5</swe:values>
            </swe:DataArray>
        </om:result>
</om:CommonObservation>
```

Note that it is also possible to remove the StationID from the data and assume that radiance values are given in the same order as individual stations in the station collection. The explicit version is preferred.

The document fragment shown in Listing 41 describes the SamplingFeature which acts as the feature of interest for the observation shown in the previous listings.

Listing 41. foi.xml#stc1

```
                    <sa:SamplingFeature gml:id="stc1">
                        <gml:description>This SamplingFeature serves as a container for a collection of
Stations</gml:description>
                        <gml:boundedBy>
                            <gml:Envelope srsName="urn:x-ogc:def:crs:EPSG:6.3:62836405">
                                <gml:lowerCorner>-30.702 134.199</gml:lowerCorner>
                                <gml:upperCorner>-30.692 134.209</gml:upperCorner>
                            </gml:Envelope>
                        </gml:boundedBy>
                        <sa:relatedSamplingFeature>
                            <sa:SamplingFeatureRelation>
                                <sa:role>member</sa:role>
                                <sa:target>
                                    <sa:Station gml:id="st1">
                                        <sa:surveyDetails xlink:href="urn:x-ogc:def:nil:OGC:unknown"/>
                                        <sa:position>
                                            <gml:Point gml:id="st1p">
                                                <gml:pos>-30.702 134.199</gml:pos>
                                            </gml:Point>
                                        </sa:position>
                                    </sa:Station>
                                </sa:target>
                            </sa:SamplingFeatureRelation>
                        </sa:relatedSamplingFeature>
                        <sa:relatedSamplingFeature>
                            <sa:SamplingFeatureRelation>
                                <sa:role>member</sa:role>
                                <sa:target>
                                    <sa:Station gml:id="st2">
                                        <sa:surveyDetails xlink:href="urn:x-ogc:def:nil:OGC:unknown"/>
                                        <sa:position>
                                            <gml:Point gml:id="st2p">
                                                <gml:pos>-30.692 134.199</gml:pos>
```

```
                                    </gml:Point>
                                </sa:position>
                            </sa:Station>
                        </sa:target>
                    </sa:SamplingFeatureRelation>
                </sa:relatedSamplingFeature>
                <sa:relatedSamplingFeature>
                    <sa:SamplingFeatureRelation>
                        <sa:role>member</sa:role>
                        <sa:target>
                            <sa:Station gml:id="st3">
                                <sa:surveyDetails xlink:href="urn:x-ogc:def:nil:OGC:unknown"/>
                                <sa:position>
                                    <gml:Point gml:id="st3p">
                                        <gml:pos>-30.702 134.209</gml:pos>
                                    </gml:Point>
                                </sa:position>
                            </sa:Station>
                        </sa:target>
                    </sa:SamplingFeatureRelation>
                </sa:relatedSamplingFeature>
                <sa:relatedSamplingFeature>
                    <sa:SamplingFeatureRelation>
                        <sa:role>member</sa:role>
                        <sa:target>
                            <sa:Station gml:id="st4">
                                <sa:surveyDetails xlink:href="urn:x-ogc:def:nil:OGC:unknown"/>
                                <sa:position>
                                    <gml:Point gml:id="st4p">
                                        <gml:pos>-30.692 134.209</gml:pos>
                                    </gml:Point>
                                </sa:position>
                            </sa:Station>
                        </sa:target>
                    </sa:SamplingFeatureRelation>
                </sa:relatedSamplingFeature>
                <sa:surveyDetails xlink:href="urn:x-ogc:def:nil:OGC:unknown"/>
            </sa:SamplingFeature>
```

This feature type is from the sampling features schema described in Clause 7. The feature is composed of four Station members. The result of the observation supplies a value for each of these elements.

4.4 Time Series

In these examples, the observation samples the phenomenon over a time period.

The documents in this sub-clause describe an observation of rainfall at a station.

In Listing 42 and 0 the observation time is a TimePeriod. The feature of interest is again indicated through links to elements in the site collection shown in Listing 41. The observation is encoded using the generic Observation.

In Listing 42 the result is given as CV_DiscreteCoverage. The domain is composed of TimePeriods, each covering a 24-hour period. The range values are measures.

Listing 42. timeSeries2.xml

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<om:Observation gml:id="timeSeries2" xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Observation test instance - time series where domain objects are explicit time
periods</gml:description>
    <gml:name>Time series 2</gml:name>
    <om:time>
        <gml:TimePeriod gml:id="ts2t">
            <gml:beginPosition>2005-06-17T09:00+08:00</gml:beginPosition>
            <gml:endPosition>2005-06-22T09:00+08:00</gml:endPosition>
        </gml:TimePeriod>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:BOM:rg23"/>
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Precipitation"/>
    <om:featureOfInterest xlink:href="foi.xml#st1"/>
    <om:result>
        <swe:CV_DiscreteCoverage>
            <swe:element>
                <swe:CV_GeometryValuePair>
                    <swe:geometry>
                        <swe:CV_DomainObject>
                            <swe:temporalElement>
                                <gml:TimePeriod gml:id="tp1">
                                    <gml:beginPosition>2005-06-17T09:00+08:00</gml:beginPosition>
                                    <gml:endPosition>2005-06-18T09:00+08:00</gml:endPosition>
                                    <gml:duration>PT24H</gml:duration>
                                </gml:TimePeriod>
                            </swe:temporalElement>
                        </swe:CV_DomainObject>
                    </swe:geometry>
                    <swe:value xsi:type="gml:MeasureType" uom="mm">10.1</swe:value>
                </swe:CV_GeometryValuePair>
            </swe:element>
            <swe:element>
                <swe:CV_GeometryValuePair>
                    <swe:geometry>
                        <swe:CV_DomainObject>
                            <swe:temporalElement>
                                <gml:TimePeriod gml:id="tp2">
                                    <gml:beginPosition>2005-06-18T09:00+08:00</gml:beginPosition>
                                    <gml:endPosition>2005-06-19T09:00+08:00</gml:endPosition>
                                    <gml:duration>PT24H</gml:duration>
                                </gml:TimePeriod>
                            </swe:temporalElement>
                        </swe:CV_DomainObject>
                    </swe:geometry>
                    <swe:value xsi:type="gml:MeasureType" uom="mm">15.7</swe:value>
                </swe:CV_GeometryValuePair>
            </swe:element>
            <swe:element>
                <swe:CV_GeometryValuePair>
                    <swe:geometry>
                        <swe:CV_DomainObject>
                            <swe:temporalElement>
                                <gml:TimePeriod gml:id="tp3">
                                    <gml:beginPosition>2005-06-19T09:00+08:00</gml:beginPosition>
                                    <gml:endPosition>2005-06-20T09:00+08:00</gml:endPosition>
                                    <gml:duration>PT24H</gml:duration>
                                </gml:TimePeriod>
                            </swe:temporalElement>
                        </swe:CV_DomainObject>
                    </swe:geometry>
                    <swe:value xsi:type="gml:MeasureType" uom="mm">20.2</swe:value>
                </swe:CV_GeometryValuePair>
            </swe:element>
            <swe:element>
                <swe:CV_GeometryValuePair>
                    <swe:geometry>
                        <swe:CV_DomainObject>
                            <swe:temporalElement>
```

```
                                        <gml:TimePeriod gml:id="tp4">
                                            <gml:beginPosition>2005-06-20T09:00+08:00</gml:beginPosition>
                                            <gml:endPosition>2005-06-21T09:00+08:00</gml:endPosition>
                                            <gml:duration>PT24H</gml:duration>
                                        </gml:TimePeriod>
                                    </swe:temporalElement>
                                </swe:CV_DomainObject>
                            </swe:geometry>
                            <swe:value xsi:type="gml:MeasureType" uom="mm">27.5</swe:value>
                        </swe:CV_GeometryValuePair>
                    </swe:element>
                    <swe:element>
                        <swe:CV_GeometryValuePair>
                            <swe:geometry>
                                <swe:CV_DomainObject>
                                    <swe:temporalElement>
                                        <gml:TimePeriod gml:id="tp5">
                                            <gml:beginPosition>2005-06-21T09:00+08:00</gml:beginPosition>
                                            <gml:endPosition>2005-06-22T09:00+08:00</gml:endPosition>
                                            <gml:duration>PT24H</gml:duration>
                                        </gml:TimePeriod>
                                    </swe:temporalElement>
                                </swe:CV_DomainObject>
                            </swe:geometry>
                            <swe:value xsi:type="gml:MeasureType" uom="mm">45.2</swe:value>
                        </swe:CV_GeometryValuePair>
                    </swe:element>
                </swe:CV_DiscreteCoverage>
            </om:result>
        </om:Observation>
```

In Listing 43 the result is given as CompactDiscreteTimeCoverage. The domain objects are simple time positions. The range values are measures.

Listing 43. timeSeries1.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="timeSeries1" xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Observation test instance - time series</gml:description>
    <gml:name>Time series 1</gml:name>
    <om:time>
        <gml:TimePeriod gml:id="ts1t">
            <gml:beginPosition>2005-06-17T09:00+08:00</gml:beginPosition>
            <gml:endPosition>2005-06-21T09:00+08:00</gml:endPosition>
        </gml:TimePeriod>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:BOM:rg23"/>
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Precipitation"/>
    <om:featureOfInterest xlink:role="urn:x-ogc:def:featureType:OGC:Station"
xlink:href="http://my.big.org/feature?type=station%26name=st1"/>
    <om:result>
        <swe:CompactDiscreteTimeCoverage>
            <swe:element>
                <swe:CompactTimeValuePair>
                    <swe:geometry>2005-06-17T09:00+08:00</swe:geometry>
                    <swe:value xsi:type="gml:MeasureType" uom="mm">10.1</swe:value>
                </swe:CompactTimeValuePair>
            </swe:element>
            <swe:element>
                <swe:CompactTimeValuePair>
                    <swe:geometry>2005-06-18T09:00+08:00</swe:geometry>
                    <swe:value xsi:type="gml:MeasureType" uom="mm">15.7</swe:value>
                </swe:CompactTimeValuePair>
```

```
                </swe:element>
                <swe:element>
                        <swe:CompactTimeValuePair>
                                <swe:geometry>2005-06-19T09:00+08:00</swe:geometry>
                                <swe:value xsi:type="gml:MeasureType" uom="mm">20.2</swe:value>
                        </swe:CompactTimeValuePair>
                </swe:element>
                <swe:element>
                        <swe:CompactTimeValuePair>
                                <swe:geometry>2005-06-20T09:00+08:00</swe:geometry>
                                <swe:value xsi:type="gml:MeasureType" uom="mm">27.5</swe:value>
                        </swe:CompactTimeValuePair>
                </swe:element>
                <swe:element>
                        <swe:CompactTimeValuePair>
                                <swe:geometry>2005-06-21T09:00+08:00</swe:geometry>
                                <swe:value xsi:type="gml:MeasureType" uom="mm">45.2</swe:value>
                        </swe:CompactTimeValuePair>
                </swe:element>
        </swe:CompactDiscreteTimeCoverage>
    </om:result>
</om:Observation>
```

In Listing 44 the same information is shown encoded as a CommonObservation. The data structure is now a list of begin time, end time and precipitation value. An extra DataGroup is used for the TimeRange in order to strictly define it using the URN “urn:x-ogc:def:phenomenon:OGC:TimePeriod”. oftware is then able to understand that those two time values correspond to a time range. Data is encoded in an ASCII tuple of space separated values. The sequence of values:
[BeginTime EndTime Precipitation] [BeginTime EndTime Precipitation] … x5

Listing 44. commonObservation4.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:CommonObservation gml:id="COMTest3" xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:swe="http://www.opengis.net/swe"
                xmlns:gml="http://www.opengis.net/gml" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:xlink="http://www.w3.org/1999/xlink"
                xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
    <gml:description>Common Observation Version of multiElement2.xml</gml:description>
    <gml:name>Multi-element 2</gml:name>
    <om:time>
        <gml:TimePeriod gml:id="overallTp">
            <gml:beginPosition>2005-06-17T09:00+08:00</gml:beginPosition>
            <gml:endPosition>2005-06-22T09:00+08:00</gml:endPosition>
            <gml:duration>PT120H</gml:duration>
        </gml:TimePeriod>
    </om:time>
    <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:BOM:rg23"/>
    <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Precipitation"/>
    <om:featureOfInterest xlink:href="foi.xml#st1"/>
    <om:result>
        <swe:DataArray>
            <swe:description>Precipitation measurements over several time periods</swe:description>
            <swe:arraySize>5</swe:arraySize>
            <swe:component name="TimeAndPrecip">
                <swe:DataGroup>
                    <swe:component name="TimeRange">
                        <swe:DataGroup definition="urn:x-ogc:def:phenomenon:OGC:TimePeriod">
                            <swe:component name="Begin">
                                <swe:Time definition="urn:x-ogc:def:phenomenon:OGC:time:iso8601"/>
                            </swe:component>
                            <swe:component name="End">
                                <swe:Time definition="urn:x-ogc:def:phenomenon:OGC:time:iso8601"/>
```

```
                                    </swe:component>
                                </swe:DataGroup>
                            </swe:component>
                            <swe:component name="Precipitation">
                                <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:Precipitation">
                                    <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:mm"/>
                                </swe:Quantity>
                            </swe:component>
                        </swe:DataGroup>
                    </swe:component>
                    <swe:encoding>
                        <swe:AsciiBlock tokenSeparator=" " tupleSeparator=" " decimalSeparator="."/>
                    </swe:encoding>
                    <swe:values>2005-06-17T09:00+08:00 2005-06-18T09:00+08:00 10.1
            2005-06-18T09:00+08:00 2005-06-19T09:00+08:00 15.7
            2005-06-19T09:00+08:00 2005-06-20T09:00+08:00 20.2
            2005-06-20T09:00+08:00 2005-06-21T09:00+08:00 27.5
            2005-06-21T09:00+08:00 2005-06-22T09:00+08:00 45.2</swe:values>
                </swe:DataArray>
        </om:result>
</om:CommonObservation>
```

4.5 Multiple compounding axes

In these examples, observations were made at a sequence of times, on elements of a compound feature of interest, and concerning a compound phenomenon.

The documents shown in Listing 45and Listing 47 describe an observation of a (raw) radiance spectrum corresponding to the LandsatTM bands, made on four stations at three time instants.

In Listing 45 the result is encoded as a CV_DiscreteCoverage. The domain objects iterate over time and space explicitly, and the range value is a Record composed of seven items.

Listing 45. spectrumSeries3.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="specSeries3" xmlns:swe="http://www.opengis.net/swe"
xmlns:om="http://www.opengeospatial.net/om/0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
        <gml:description>Observation test instance - Multiple compounding axes
        A Landsat TM spectrum is observed on 4 stations at 5 time instants</gml:description>
        <gml:name>Spectrum Series</gml:name>
        <om:time>
                <gml:TimePeriod gml:id="tpss1">
                        <gml:beginPosition>2005-06-17</gml:beginPosition>
                        <gml:endPosition>2005-06-21</gml:endPosition>
                </gml:TimePeriod>
        </om:time>
        <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:NASA:Landsat7"/>
        <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:DiscreteSpectrumTM"/>
        <om:featureOfInterest xlink:href="foi.xml#stc1"/>
        <om:resultDefinition xlink:href="tm7.xml#tm7"/>
        <om:result>
                <swe:CV_DiscreteCoverage>
                        <swe:element>
                                <swe:CV_GeometryValuePair>
                                        <swe:geometry>
                                                <swe:CV_DomainObject>
                                                        <swe:spatialElement xlink:href="./foi.xml#st1"/>
                                                        <swe:temporalElement xlink:href="./toi.xml#ti1"/>
```

```
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>9</swe:Item></swe:field>
                        <swe:field><swe:Item>8</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                        <swe:field><swe:Item>6</swe:Item></swe:field>
                        <swe:field><swe:Item>5</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st3"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti1"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>1</swe:Item></swe:field>
                        <swe:field><swe:Item>2</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                        <swe:field><swe:Item>5</swe:Item></swe:field>
                        <swe:field><swe:Item>6</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st2"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti1"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>1</swe:Item></swe:field>
                        <swe:field><swe:Item>9</swe:Item></swe:field>
                        <swe:field><swe:Item>2</swe:Item></swe:field>
                        <swe:field><swe:Item>8</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st4"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti1"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>5</swe:Item></swe:field>
                        <swe:field><swe:Item>6</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
```

```
                        <swe:field><swe:Item>2</swe:Item></swe:field>
                        <swe:field><swe:Item>8</swe:Item></swe:field>
                        <swe:field><swe:Item>1</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st1"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti3"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>9</swe:Item></swe:field>
                        <swe:field><swe:Item>8</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                        <swe:field><swe:Item>6</swe:Item></swe:field>
                        <swe:field><swe:Item>5</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st3"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti3"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>1</swe:Item></swe:field>
                        <swe:field><swe:Item>2</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                        <swe:field><swe:Item>5</swe:Item></swe:field>
                        <swe:field><swe:Item>6</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
            <swe:CV_GeometryValuePair>
                <swe:geometry>
                    <swe:CV_DomainObject>
                        <swe:spatialElement xlink:href="./foi.xml#st2"/>
                        <swe:temporalElement xlink:href="./toi.xml#ti3"/>
                    </swe:CV_DomainObject>
                </swe:geometry>
                <swe:value>
                    <swe:Record>
                        <swe:field><swe:Item>1</swe:Item></swe:field>
                        <swe:field><swe:Item>9</swe:Item></swe:field>
                        <swe:field><swe:Item>2</swe:Item></swe:field>
                        <swe:field><swe:Item>8</swe:Item></swe:field>
                        <swe:field><swe:Item>3</swe:Item></swe:field>
                        <swe:field><swe:Item>7</swe:Item></swe:field>
                        <swe:field><swe:Item>4</swe:Item></swe:field>
                    </swe:Record>
                </swe:value>
            </swe:CV_GeometryValuePair>
        </swe:element>
        <swe:element>
```

```
        <swe:CV_GeometryValuePair>
            <swe:geometry>
                <swe:CV_DomainObject>
                    <swe:spatialElement xlink:href="./foi.xml#st4"/>
                    <swe:temporalElement xlink:href="./toi.xml#ti3"/>
                </swe:CV_DomainObject>
            </swe:geometry>
            <swe:value>
                <swe:Record>
                    <swe:field><swe:Item>5</swe:Item></swe:field>
                    <swe:field><swe:Item>6</swe:Item></swe:field>
                    <swe:field><swe:Item>3</swe:Item></swe:field>
                    <swe:field><swe:Item>7</swe:Item></swe:field>
                    <swe:field><swe:Item>2</swe:Item></swe:field>
                    <swe:field><swe:Item>8</swe:Item></swe:field>
                    <swe:field><swe:Item>1</swe:Item></swe:field>
                </swe:Record>
            </swe:value>
        </swe:CV_GeometryValuePair>
    </swe:element>
    <swe:element>
        <swe:CV_GeometryValuePair>
            <swe:geometry>
                <swe:CV_DomainObject>
                    <swe:spatialElement xlink:href="./foi.xml#st1"/>
                    <swe:temporalElement xlink:href="./toi.xml#ti5"/>
                </swe:CV_DomainObject>
            </swe:geometry>
            <swe:value>
                <swe:Record>
                    <swe:field><swe:Item>9</swe:Item></swe:field>
                    <swe:field><swe:Item>8</swe:Item></swe:field>
                    <swe:field><swe:Item>7</swe:Item></swe:field>
                    <swe:field><swe:Item>6</swe:Item></swe:field>
                    <swe:field><swe:Item>5</swe:Item></swe:field>
                    <swe:field><swe:Item>4</swe:Item></swe:field>
                    <swe:field><swe:Item>3</swe:Item></swe:field>
                </swe:Record>
            </swe:value>
        </swe:CV_GeometryValuePair>
    </swe:element>
    <swe:element>
        <swe:CV_GeometryValuePair>
            <swe:geometry>
                <swe:CV_DomainObject>
                    <swe:spatialElement xlink:href="./foi.xml#st3"/>
                    <swe:temporalElement xlink:href="./toi.xml#ti5"/>
                </swe:CV_DomainObject>
            </swe:geometry>
            <swe:value>
                <swe:Record>
                    <swe:field><swe:Item>1</swe:Item></swe:field>
                    <swe:field><swe:Item>2</swe:Item></swe:field>
                    <swe:field><swe:Item>3</swe:Item></swe:field>
                    <swe:field><swe:Item>4</swe:Item></swe:field>
                    <swe:field><swe:Item>5</swe:Item></swe:field>
                    <swe:field><swe:Item>6</swe:Item></swe:field>
                    <swe:field><swe:Item>7</swe:Item></swe:field>
                </swe:Record>
            </swe:value>
        </swe:CV_GeometryValuePair>
    </swe:element>
    <swe:element>
        <swe:CV_GeometryValuePair>
            <swe:geometry>
                <swe:CV_DomainObject>
                    <swe:spatialElement xlink:href="./foi.xml#st2"/>
                    <swe:temporalElement xlink:href="./toi.xml#ti5"/>
                </swe:CV_DomainObject>
            </swe:geometry>
            <swe:value>
```

```
                                <swe:Record>
                                    <swe:field><swe:Item>1</swe:Item></swe:field>
                                    <swe:field><swe:Item>9</swe:Item></swe:field>
                                    <swe:field><swe:Item>2</swe:Item></swe:field>
                                    <swe:field><swe:Item>8</swe:Item></swe:field>
                                    <swe:field><swe:Item>3</swe:Item></swe:field>
                                    <swe:field><swe:Item>7</swe:Item></swe:field>
                                    <swe:field><swe:Item>4</swe:Item></swe:field>
                                </swe:Record>
                            </swe:value>
                        </swe:CV_GeometryValuePair>
                    </swe:element>
                    <swe:element>
                        <swe:CV_GeometryValuePair>
                            <swe:geometry>
                                <swe:CV_DomainObject>
                                    <swe:spatialElement xlink:href="./foi.xml#st4"/>
                                    <swe:temporalElement xlink:href="./toi.xml#ti5"/>
                                </swe:CV_DomainObject>
                            </swe:geometry>
                            <swe:value>
                                <swe:Record>
                                    <swe:field><swe:Item>5</swe:Item></swe:field>
                                    <swe:field><swe:Item>6</swe:Item></swe:field>
                                    <swe:field><swe:Item>3</swe:Item></swe:field>
                                    <swe:field><swe:Item>7</swe:Item></swe:field>
                                    <swe:field><swe:Item>2</swe:Item></swe:field>
                                    <swe:field><swe:Item>8</swe:Item></swe:field>
                                    <swe:field><swe:Item>1</swe:Item></swe:field>
                                </swe:Record>
                            </swe:value>
                        </swe:CV_GeometryValuePair>
                    </swe:element>
                </swe:CV_DiscreteCoverage>
            </om:result>
        </om:Observation>
```

The document shown in Listing 46 describes the details of the representation of the value of the observed property, as a RecordDefinition.

Listing 46. tm7.xml

```
<?xml version="1.0"?>
<swe:RecordDefinition gml:id="tm7" recordLength="7" xmlns:xst="http://www.opengis.net/swe/st"
                      xmlns:swe="http://www.opengis.net/swe" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                      xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
                      xsi:schemaLocation="http://www.opengis.net/swe ../recordType.xsd">
    <gml:identifier codeSpace="http://generic.org">TMraw</gml:identifier>
    <gml:name>Thematic mapper raw counts</gml:name>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM1">
            <gml:identifier codeSpace="http://generic.org">TM1</gml:identifier>
            <gml:name>Thematic Mapper band 1</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand1"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
                    </xst:restriction>
                    <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                </swe:SimpleType>
            </swe:representation>
        </swe:FieldDefinition >
    </swe:field>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM2">
            <gml:identifier codeSpace="http://generic.org">TM2</gml:identifier>
```

```
            <gml:name>Thematic Mapper band 2</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand2"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
                    </xst:restriction>
                    <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                </swe:SimpleType>
            </swe:representation>
        </swe:FieldDefinition >
    </swe:field>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM3">
            <gml:identifier codeSpace="http://generic.org">TM3</gml:identifier>
            <gml:name>Thematic Mapper band 3</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand3"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
                    </xst:restriction>
                    <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                </swe:SimpleType>
            </swe:representation>
        </swe:FieldDefinition >
    </swe:field>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM4">
            <gml:identifier codeSpace="http://generic.org">TM4</gml:identifier>
            <gml:name>Thematic Mapper band 4</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand4"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
                    </xst:restriction>
                    <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                </swe:SimpleType>
            </swe:representation>
        </swe:FieldDefinition >
    </swe:field>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM5">
            <gml:identifier codeSpace="http://generic.org">TM5</gml:identifier>
            <gml:name>Thematic Mapper band 5</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand5"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
                    </xst:restriction>
                    <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                </swe:SimpleType>
            </swe:representation>
        </swe:FieldDefinition >
    </swe:field>
    <swe:field>
        <swe:FieldDefinition  gml:id="TM6">
            <gml:identifier codeSpace="http://generic.org">TM6</gml:identifier>
            <gml:name>Thematic Mapper band 6</gml:name>
            <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand6"/>
            <swe:representation>
                <swe:SimpleType>
                    <xst:restriction base="xst:integer">
                        <xst:minInclusive value="0"/>
                        <xst:maxInclusive value="255"/>
```

```
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition >
        </swe:field>
        <swe:field>
            <swe:FieldDefinition  gml:id="TM7">
                <gml:identifier codeSpace="http://generic.org">TM7</gml:identifier>
                <gml:name>Thematic Mapper band 7</gml:name>
                <swe:property xlink:href="urn:x-ogc:def:phenomenon:OGC:TMBand7"/>
                <swe:representation>
                    <swe:SimpleType>
                        <xst:restriction base="xst:integer">
                            <xst:minInclusive value="0"/>
                            <xst:maxInclusive value="255"/>
                        </xst:restriction>
                        <gml:unitOfMeasure uom="urn:x-ogc:def:uom:OGC:count"/>
                    </swe:SimpleType>
                </swe:representation>
            </swe:FieldDefinition >
        </swe:field>
</swe:RecordDefinition>
```

Note that the **representation** element contains a SimpleType definition which is based on the XML Schema syntax. This allows use of the XML Schema built-in types as a base, and allows restriction facets to be applied (e.g. min and max values) as per the W3C XML Schema (Part 2) recommendation. The swe:SimpleType structure adds a *scale* element—either uom or codeSpace. .

In Listing 47 the information shown in Listing 45 is encoded as a CommonObservation. In this complex example, results need to be related to both a feature of interest (indicated by a StationID) and a time of interest. The data structure shown is a tuple of this form:
[Time [StationID TM1 TM2 TM3 TM4 TM5 TM6 TM7]
        [StationID TM1 TM2 TM3 TM4 TM5 TM6 TM7] … x4]

This is specified in the resultDefinition using a DataGroup containing a time value and an array of size 4. The array itself contains a group of 8 components: the Station ID and 7 TM measurements. The data contains values of 3 tuples of the type specified above.

Listing 47. commonObservation5.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<om:CommonObservation gml:id="COMTest3"
xmlns:om="http://www.opengeospatial.net/om/0.0"
xmlns:swe="http://www.opengis.net/swe"
xmlns:gml="http://www.opengis.net/gml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://www.opengeospatial.net/om/0.0 ../om.xsd">
  <gml:description>Observation test instance - Multiple compounding axes
    A Landsat TM spectrum is observed on 4 stations at 3 time instants</gml:description>
  <gml:name>Spectrum Series</gml:name>
  <om:time xlink:href="toi.xml#ta1"/>
  <om:procedure xlink:href="urn:x-ogc:object:feature:Sensor:NASA:Landsat7"/>
  <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:DiscreteSpectrumTM"/>
  <om:featureOfInterest xlink:href="foi.xml#stc1"/>
  <om:result>
    <swe:DataArray>
```

```
<swe:description> Three sets of complex measurements consisting of a time stamp
   and Landsat TM spectrum measurements for four stations
</swe:description>
<swe:arraySize> 3 </swe:arraySize>
<swe:component name="timeSeries">
  <swe:DataGroup>
    <swe:component name="Time">
      <swe:Time definition="urn:x-ogc:def:phenomenon:OGC:time:iso8601"/>
    </swe:component>
    <swe:component name="measurementSeries">
      <swe:DataArray>
       <swe:arraySize> 4 </swe:arraySize>
        <swe:component name="stationMeasure">
          <swe:DataGroup>
            <swe:component name="StationID">
              <swe:Category definition="foi.xml#stc1"/>
            </swe:component>
            <swe:component name="TMBand1">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand1">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint>
                  <swe:AllowedValues id="SINGLE_BYTE">
                    <swe:interval>0 255</swe:interval>
                  </swe:AllowedValues>
                </swe:constraint>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand2">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand2">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand3">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand3">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand4">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand4">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand5">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand5">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand6">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand6">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
            <swe:component name="TMBand7">
              <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand7">
                <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:count"/>
                <swe:constraint xlink:href="#SINGLE_BYTE"/>
              </swe:Quantity>
            </swe:component>
          </swe:DataGroup>
        </swe:component>
      </swe:DataArray>
    </swe:component>
  </swe:DataGroup>
</swe:component>
<swe:encoding>
  <swe:AsciiBlock tokenSeparator="&#x20;" tupleSeparator="&#x20;" decimalSeparator="."/>
```

```
      </swe:encoding>
        <swe:values>
          2005-06-17T09:00+08:00
          st1 9 8 7 6 5 4 3
          st2 1 2 3 4 5 6 7
          st3 1 9 2 8 3 7 4
          st4 5 6 3 7 2 8 1
          2005-06-18T09:00+08:00
          st1 9 8 7 6 5 4 3
          st2 1 2 3 4 5 6 7
          st3 1 9 2 8 3 7 4
          st4 5 6 3 7 2 8 1
          2005-06-19T09:00+08:00
          st1 9 8 7 6 5 4 3
          st2 1 2 3 4 5 6 7
          st3 1 9 2 8 3 7 4
          st4 5 6 3 7 2 8 1
        </swe:values>
      </swe:DataArray>
  </om:result>
</om:CommonObservation>
```

4.6 Comparison of explicit and compact encodings

The documents shown in Listing 45 and Listing 47 provide a clear comparison of the explicit XML interleaved coverage encoding, and the compact encoding.

Two documents are required for the coverage-based encoding in a generic Observation, while all the information is in a single document for the CommonObservation encoding.

The two document treatment is three times the size of the CommonObservation document, so judged on this simple criterion the CommonObservation encoding is more efficient. Note, however, that in compressed form (“zip”) the ratio shrinks to only 1.5 as the redundancy in the XML-encoded form is exploited. The difference shrinks further for larger datasets.

Another important issue is that when the “result definition” is in a separate document then this may be provided independently and then used repeatedly “by reference”. This scenario supports the important use-case where the record-structure is part of a standard “data product specification”, in which case the record structure would be published in a standard location (e.g. a register).

A balanced choice should take into account the real use-cases, as well as document size and processing difficulty. Concerning the latter, the CommonObservation examples include non-XML data, so a second non-standard parsing step is required, which adds an additional processing overhead.

5 Phenomenon dictionary

The document shown in Listing 48 shows a dictionary of phenomenon definitions used in many of the examples.

Listing 48. phenomena.xml

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<gml:Dictionary xmlns:gml="http://www.opengis.net/gml" xmlns:swe="http://www.opengis.net/swe"
        xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.opengis.net/swe ../../../sweCommon/current/phenomenon.xsd"
gml:id="phenomena_xsd">
    <gml:description>A dictionary of phenomena, compiled through OWS-1, OWS-1.2 OWS-3.
SJDC 2005-10-03</gml:description>
    <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-ogc:def:phenomenon:OGC:ALL</gml:identifier>
    <gml:name>OWS Phenomena</gml:name>
    <gml:dictionaryEntry>
        <swe:ConstrainedPhenomenon gml:id="_19V">
            <gml:description>19 GHz Radiation Vertical Polarisation</gml:description>
            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:19V</gml:identifier>
            <gml:name>19V</gml:name>
            <swe:base xlink:href="#Radiation"/>
            <swe:singleConstraint>
                <swe:TypedValue>
                    <swe:property codeSpace="./">PeakWavelength</swe:property>
                    <swe:value xsi:type="gml:MeasureType" uom="./units.xml#GHz">19.35</swe:value>
                </swe:TypedValue>
            </swe:singleConstraint>
            <swe:singleConstraint>
                <swe:TypedValue>
                    <swe:property codeSpace="./">PolarisationDirection</swe:property>
                    <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/sensorGlossary">V</swe:value>
                </swe:TypedValue>
            </swe:singleConstraint>
        </swe:ConstrainedPhenomenon>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <swe:ConstrainedPhenomenon gml:id="_19H">
            <gml:description>19 GHz Radiation Horizontal Polarisation</gml:description>
            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:19H</gml:identifier>
            <gml:name>19H</gml:name>
            <swe:base xlink:href="#Radiation"/>
            <swe:singleConstraint>
                <swe:TypedValue>
                    <swe:property codeSpace="./">peakWavelength</swe:property>
                    <swe:value xsi:type="gml:MeasureType" uom="#GHz">19.35</swe:value>
                </swe:TypedValue>
            </swe:singleConstraint>
            <swe:singleConstraint>
                <swe:TypedValue>
                    <swe:property codeSpace="./">PolarisationDirection</swe:property>
                    <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/sensorGlossary">H</swe:value>
                </swe:TypedValue>
            </swe:singleConstraint>
        </swe:ConstrainedPhenomenon>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <swe:Phenomenon gml:id="Age">
            <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/time.owl#Age">Time duration since
creation</gml:description>
            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Age</gml:identifier>
            <gml:name>Age</gml:name>
        </swe:Phenomenon>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <swe:Phenomenon gml:id="AtmosphericPressure">
            <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#AtmosphericPressure">fluid
pressure exerted due to the gravitational effect on the column of atmosphere above the position of
interest</gml:description>
            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:AtmosphericPressure</gml:identifier>
            <gml:name>Atmospheric Pressure</gml:name>
        </swe:Phenomenon>
    </gml:dictionaryEntry>
```

```
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="CloudCover">
                <gml:description>fraction of sky occupied by visible cloud</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:CloudCover</gml:identifier>
                <gml:name>Cloud Cover</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Concentration">
                <gml:description
xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#MassConcentration">Amount of substance as a fraction of host
medium;
                the type of substance can be indicated by appending a symbol at the end of the URN - e.g. urn:x-
ogc:def:phenomenon:OGC:Concentration[Sb] for concentration of Antimony</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Concentration</gml:identifier>
                <gml:name>Concentration</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Density">
                <gml:description/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Density</gml:identifier>
                <gml:name>Density</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Depth">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Depth">Linear distance
measured vertically downwards from a reference surface</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Depth</gml:identifier>
                <gml:name>Depth</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="DewPointTemperature">
                <gml:description
xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#DewPointTemperature">Temperature at which water
condensation occurs, providing an indirect measure of humidity</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:DewPointTemperature</gml:identifier>
                <gml:name>Dew Point Temperature</gml:name>
                <gml:name>Dew Point</gml:name>
                <swe:base xlink:href="#Humidity"/>
                <swe:otherConstraint>Condensation temperature</swe:otherConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Direction">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/space.owl#Direction">Orientation of a
vector relative to a reference frame.</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Direction</gml:identifier>
                <gml:name>Direction</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="DissolvedSolids">
                <gml:description
xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#DissolvedConcentration">Amount of solids remaining after
evaporation</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:DissolvedSolids</gml:identifier>
                <gml:name>Dissolved Solids</gml:name>
                <swe:base xlink:href="Concentration"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Material</swe:property>
```

```
                                <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">total solute</swe:value>
                            </swe:TypedValue>
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="DOX">
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:DOX</gml:identifier>
                        <gml:name>Dissolved Oxygen</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:CompositePhenomenon gml:id="EarthquakeParameters" dimension="2">
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:EarthquakeParameters</gml:identifier>
                        <gml:name>Earthquake Parameters</gml:name>
                        <swe:component>
                            <swe:CompositePhenomenon gml:id="EarthquakeLocation" dimension="3">
                                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:EarthquakeLocation</gml:identifier>
                                <gml:name>Earthquake Location</gml:name>
                                <swe:component xlink:href="#Epicentre"/>
                                <swe:component xlink:href="#Depth"/>
                                <swe:component xlink:href="#OriginTime"/>
                            </swe:CompositePhenomenon>
                        </swe:component>
                        <swe:component>
                            <swe:CompositePhenomenon gml:id="MomentTensor" dimension="6">
                                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MomentTensor</gml:identifier>
                                <gml:name>Earthquake Moment Tensor</gml:name>
                                <swe:component xlink:href="#Mrr"/>
                                <swe:component xlink:href="#Mtt"/>
                                <swe:component xlink:href="#Mff"/>
                                <swe:component xlink:href="#Mrt"/>
                                <swe:component xlink:href="#Mrf"/>
                                <swe:component xlink:href="#Mtf"/>
                            </swe:CompositePhenomenon>
                        </swe:component>
                    </swe:CompositePhenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Elevation">
                        <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Elevation">Linear distance
measured vertically upwards from a reference surface</gml:description>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Elevation</gml:identifier>
                        <gml:name>Elevation</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Epicentre">
                        <gml:description>The location on the surface of the earth directly above the position of the origin of an
earthquake</gml:description>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Epicentre</gml:identifier>
                        <gml:name>Epicentre</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:ConstrainedPhenomenon gml:id="Humidity">
                        <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Humidity">Concentration of
water</gml:description>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Humidity</gml:identifier>
                        <gml:name>Humidity</gml:name>
                        <swe:base xlink:href="Concentration"/>
                        <swe:singleConstraint>
                            <swe:TypedValue>
```

```
                                <swe:property codeSpace="./">Material</swe:property>
                                <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">Water</swe:value>
                            </swe:TypedValue>
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Medium">
                        <gml:description>Material of which an object is constructed or within which a phenomenon
occurs</gml:description>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Medium</gml:identifier>
                        <gml:name>Medium</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mrr">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mrr"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:"Mrr</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mrr</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mtt">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mtt"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Mtt</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mtt</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mff">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mff"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Mff</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mff</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mrt">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mrt"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Mrt</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mrt</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mrf">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mrf"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Mrf</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mrf</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="Mtf">
                        <gml:description xlink:href="http://biggeophysicsdictionary.org/parameters/earthquakes/moment/Mtf"/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Mtf</gml:identifier>
                        <gml:name>Earthquake Moment Tensor component Mtf</gml:name>
                    </swe:Phenomenon>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
                    <swe:Phenomenon gml:id="MolWt">
                        <gml:description/>
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MolWt</gml:identifier>
                        <gml:name>Molecular weight</gml:name>
                    </swe:Phenomenon>
```

```
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="MolVol">
                <gml:description/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MolVol</gml:identifier>
                <gml:name>Molecular volume</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="OrganismCount">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Population">Number of
organisms</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:OrganismCount</gml:identifier>
                <gml:name>Organism count</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="OriginTime">
                <gml:description>The time instant corresponding to the initiation of the event.</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:OriginTime</gml:identifier>
                <gml:name>Origin Time</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="PeakWavelength">
                <gml:description>Centre of wavelength sensitivity band</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:PeakWavelength</gml:identifier>
                <gml:name>Peak Wavelength</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Precipitation">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Rainfall"></gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Precipitation</gml:identifier>
                <gml:name>Rainfall</gml:name>
                <gml:name>Precipitation</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="Precipitation1Hour">
                <gml:description>Percipitation - over 1 hour</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Precipitation1Hour</gml:identifier>
                <gml:name>Precipitation1Hour</gml:name>
                <swe:base xlink:href="#Precipitation"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">TimeAverage</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">3600</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="Precipitation24Hour">
                <gml:description>Percipitation - over 24 hours</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Precipitation24Hour</gml:identifier>
                <gml:name>Precipitation24Hour</gml:name>
                <swe:base xlink:href="#Precipitation"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">TimeAverage</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">86400</swe:value>
```

```
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Radiation">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#RadiantEnergy"/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Radiation</gml:identifier>
                <gml:name>Radiation</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="Radiance">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Radiance"/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Radiance</gml:identifier>
                <gml:name>Radiance</gml:name>
                <swe:base xlink:href="#Radiation"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="urn:x-ogc:def:nil:OGC:unknown">mode</swe:property>
                        <swe:value xsi:type="gml:CodeType">passive</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="RelativeHumidity">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Humidity">Amount of water
vapour in a gas measured as a fraction of full saturation</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:RelativeHumidity</gml:identifier>
                <gml:name>Relative Humidity</gml:name>
                <swe:base xlink:href="#Humidity"/>
                <swe:otherConstraint>Normalised</swe:otherConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Shape">
                <gml:description>The geometry of the boundary of the object of interest</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Shape</gml:identifier>
                <gml:name>Shape</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Species">
                <gml:description>The kind of thing</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Species</gml:identifier>
                <gml:name>Species</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Speed">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Speed">Scalar rate of
movement</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Speed</gml:identifier>
                <gml:name>Speed</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:CompositePhenomenon gml:id="DiscreteSpectrumTM" dimension="7">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:DiscreteSpectrumTM</gml:identifier>
                <gml:name>Landsat Thematic Mapper spectrum</gml:name>
                <swe:base xlink:href="#Radiance"/>
                <swe:component>
                    <swe:ConstrainedPhenomenon gml:id="TMBand1">
```

```
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand1</gml:identifier>
                        <gml:name>Landsat TM band 1</gml:name>
                        <swe:base xlink:href="#Radiance"/>
                        <swe:singleConstraint>
                            <swe:TypedValue>
                                <swe:property codeSpace="./">Wavelength</swe:property>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.45</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.52</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                            </swe:TypedValue>
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </swe:component>
                <swe:component>
                    <swe:ConstrainedPhenomenon gml:id="TMBand2">
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand2</gml:identifier>
                        <gml:name>Landsat TM band 2</gml:name>
                        <swe:base xlink:href="#Radiance"/>
                        <swe:singleConstraint>
                            <swe:TypedValue>
                                <swe:property codeSpace="./">Wavelength</swe:property>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.52</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.60</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                            </swe:TypedValue>
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </swe:component>
                <swe:component>
                    <swe:ConstrainedPhenomenon gml:id="TMBand3">
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand3</gml:identifier>
                        <gml:name>Landsat TM band 3</gml:name>
                        <swe:base xlink:href="#Radiance"/>
                        <swe:singleConstraint>
                            <swe:TypedValue>
                                <swe:property codeSpace="./">Wavelength</swe:property>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.63</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.69</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                            </swe:TypedValue>
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </swe:component>
                <swe:component>
                    <swe:ConstrainedPhenomenon gml:id="TMBand4">
                        <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand4</gml:identifier>
                        <gml:name>Landsat TM band 4</gml:name>
                        <swe:base xlink:href="#Radiance"/>
                        <swe:singleConstraint>
                            <swe:TypedValue>
                                <swe:property codeSpace="./">Wavelength</swe:property>
                                <swe:value>
```

```
                                        <swe:Interval>
                                            <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.76</swe:lowerBound>
                                            <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.90</swe:upperBound>
                                        </swe:Interval>
                                    </swe:value>
                                </swe:TypedValue>
                            </swe:singleConstraint>
                        </swe:ConstrainedPhenomenon>
                    </swe:component>
                    <swe:component>
                        <swe:ConstrainedPhenomenon gml:id="TMBand5">
                            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand5</gml:identifier>
                            <gml:name>Landsat TM band 5</gml:name>
                            <swe:base xlink:href="#Radiance"/>
                            <swe:singleConstraint>
                                <swe:TypedValue>
                                    <swe:property codeSpace="./">Wavelength</swe:property>
                                    <swe:value>
                                        <swe:Interval>
                                            <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">1.55</swe:lowerBound>
                                            <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">1.75</swe:upperBound>
                                        </swe:Interval>
                                    </swe:value>
                                </swe:TypedValue>
                            </swe:singleConstraint>
                        </swe:ConstrainedPhenomenon>
                    </swe:component>
                    <swe:component>
                        <swe:ConstrainedPhenomenon gml:id="TMBand6">
                            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand6</gml:identifier>
                            <gml:name>Landsat TM band 6</gml:name>
                            <swe:base xlink:href="#Radiance"/>
                            <swe:singleConstraint>
                                <swe:TypedValue>
                                    <swe:property codeSpace="./">Wavelength</swe:property>
                                    <swe:value>
                                        <swe:Interval>
                                            <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">10.4</swe:lowerBound>
                                            <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">12.5</swe:upperBound>
                                        </swe:Interval>
                                    </swe:value>
                                </swe:TypedValue>
                            </swe:singleConstraint>
                        </swe:ConstrainedPhenomenon>
                    </swe:component>
                    <swe:component>
                        <swe:ConstrainedPhenomenon gml:id="TMBand7">
                            <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TMBand7</gml:identifier>
                            <gml:name>Landsat TM band 7</gml:name>
                            <swe:base xlink:href="#Radiance"/>
                            <swe:singleConstraint>
                                <swe:TypedValue>
                                    <swe:property codeSpace="./">Wavelength</swe:property>
                                    <swe:value>
                                        <swe:Interval>
                                            <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">2.08</swe:lowerBound>
                                            <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">2.35</swe:upperBound>
                                        </swe:Interval>
                                    </swe:value>
                                </swe:TypedValue>
```

```
                        </swe:singleConstraint>
                    </swe:ConstrainedPhenomenon>
                </swe:component>
            </swe:CompositePhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="SurfaceWaterTemperature2">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:SurfaceWaterTemperature2</gml:identifier>
                <gml:name>Surface Water Temperature 2</gml:name>
                <swe:base xlink:href="#Temperature"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">water</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Depth</swe:property>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#m">0.0</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#m">1.5</swe:upperBound>
                            </swe:Interval>
                        </swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="SurfaceWaterTemperature">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:SurfaceWaterTemperature</gml:identifier>
                <gml:name>Surface Water Temperature</gml:name>
                <swe:base xlink:href="#WaterTemperature"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Depth</swe:property>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#m">0.0</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#m">1.5</swe:upperBound>
                            </swe:Interval>
                        </swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Temperature">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Temperature</gml:identifier>
                <gml:name>Temperature</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="TimePosition">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/time.owl#Instant">A position on a time
scale</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:TimePosition</gml:identifier>
                <gml:name>Time Position</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
```

```
        <gml:dictionaryEntry>
            <swe:PhenomenonSeries gml:id="uSpectrum" dimension="17">
                <gml:description>Simple spectrum with uniform spacing of bands</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:uSpectrum</gml:identifier>
                <gml:name>UniformSpectrum</gml:name>
                <swe:base xlink:href="#Radiance"/>
                <swe:constraintList>
                    <swe:TypedValueList>
                        <swe:property codeSpace="./">Wavelength</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.300</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.304</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.308</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.312</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.316</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.320</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.324</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.328</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.332</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.336</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.340</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.344</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.348</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.352</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.356</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.360</swe:value>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#um">0.364</swe:value>
                    </swe:TypedValueList>
                </swe:constraintList>
            </swe:PhenomenonSeries>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:PhenomenonSeries dimension="12" gml:id="Radiance12cA">
                <gml:description>12-Channel Radiance for NNNNNNNNN</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Radiance12cA</gml:identifier>
                <gml:name>12-Channel_Radiance</gml:name>
                <swe:base xlink:href="#Radiance"/>
                <swe:constraintList>
                    <swe:TypedValueList>
                        <swe:property codeSpace="./">Wavelength</swe:property>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.42</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.45</swe:upperBound>
                            </swe:Interval>
                        </swe:value>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.45</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.52</swe:upperBound>
                            </swe:Interval>
                        </swe:value>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.52</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.60</swe:upperBound>
                            </swe:Interval>
                        </swe:value>
                        <swe:value>
                            <swe:Interval>
                                <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.60</swe:lowerBound>
                                <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.62</swe:upperBound>
```

```
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.63</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.69</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.69</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.75</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.76</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.90</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">0.91</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">1.05</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">1.55</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">1.75</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">2.08</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">2.35</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">3.60</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">3.79</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                                <swe:value>
                                    <swe:Interval>
                                        <swe:lowerBound xsi:type="gml:MeasureType"
uom="./units.xml#um">10.26</swe:lowerBound>
                                        <swe:upperBound xsi:type="gml:MeasureType"
uom="./units.xml#um">11.26</swe:upperBound>
                                    </swe:Interval>
                                </swe:value>
                            </swe:TypedValueList>
                        </swe:constraintList>
                    </swe:PhenomenonSeries>
                </gml:dictionaryEntry>
                <gml:dictionaryEntry>
```

```
            <swe:CompositePhenomenon gml:id="Velocity" dimension="2">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Velocity">Vector rate of
movement relative to a reference frame</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Velocity</gml:identifier>
                <gml:name>Velocity</gml:name>
                <swe:component xlink:href="#Speed"/>
                <swe:component xlink:href="#Direction"/>
            </swe:CompositePhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="WaterTemperature">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:WaterTemperature</gml:identifier>
                <gml:name>Water Temperature</gml:name>
                <swe:base xlink:href="#Temperature"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">water</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Visibility">
                <gml:description>Atmospheric visibility</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Visibility</gml:identifier>
                <gml:name>Visibility</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Wavelength">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Wavelength">Distance
between peak values of a wave</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Wavelength</gml:identifier>
                <gml:name>Wavelength</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="WindChill">
                <gml:description xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#WindChill"/>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:WindChill</gml:identifier>
                <gml:name>Wind Chill</gml:name>
                <swe:base xlink:href="#Temperature"/>
                <swe:otherConstraint>Corrected for wind speed</swe:otherConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="WindDirection">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:WindDirection</gml:identifier>
                <gml:name>Wind Direction</gml:name>
                <swe:base xlink:href="#Direction"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType">Wind</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="WindSpeed">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:WindSpeed</gml:identifier>
                <gml:name>Wind Speed</gml:name>
```

```
                <swe:base xlink:href="#Speed"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType">Air</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="WindVelocity">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:WindVelocity</gml:identifier>
                <gml:name>Wind Velocity</gml:name>
                <swe:base xlink:href="#Velocity"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType">Air</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <!-- ================== -->
        <!-- Added by Mark Priest for OWS3-SWE - comments by Simon Cox -->
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="TimeAverage">
                <gml:description>Statistical mean value in a time series of data</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Average</gml:identifier>
                <gml:name>Average</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="TimeMax">
                <gml:description>Statistical maximum value in a time series of data</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Max</gml:identifier>
                <gml:name>Max</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="TimeMin">
                <gml:description>Statistical minimum value in a time series of data</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Min</gml:identifier>
                <gml:name>Min</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Chemical">
                <gml:description>Chemical compound - ********** should this be formulated as
ConstrainedPhenomenon species(chemical) ? **********</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Chemical</gml:identifier>
                <gml:name>Chemical</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <!-- the following series are clearly all related so should be formulated as a set of related ConstrainedPhenomenon
definitions -->
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAir">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresence</gml:identifier>
                <gml:name>Chemical presence (as apposed to absence)</gml:name>
                <swe:base xlink:href="#Chemical"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">Air</swe:value>
```

```
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirDPM">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirDPM</gml:identifier>
                <gml:name>DPM chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">DPM</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirMS">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirMS</gml:identifier>
                <gml:name>MS chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">MS</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirGA">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirGA</gml:identifier>
                <gml:name>GA chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">GA</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirGB">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirGB</gml:identifier>
                <gml:name>GB chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">GB</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirGD_GF">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirGD_GF</gml:identifier>
                <gml:name>GD_GF chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">GD_GF</swe:value>
                    </swe:TypedValue>
```

```
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirVX">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirVX</gml:identifier>
                <gml:name>VX chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">VX</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="ChemicalPresenceInAirHD">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:ChemicalPresenceInAirHD</gml:identifier>
                <gml:name>HD chemical presence</gml:name>
                <swe:base xlink:href="#ChemicalPresenceInAir"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Chemical</swe:property>
                        <swe:value xsi:type="gml:CodeType" codeSpace="./">HD</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <!-- ============== -->
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="AirTemperature">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:AirTemperature</gml:identifier>
                <gml:name>Air Temperature</gml:name>
                <swe:base xlink:href="#Temperature"/>
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Medium</swe:property>
                        <swe:value xsi:type="gml:CodeType"
codeSpace="http://www.opengis.net/ows/material">Air</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="AverageWindSpeed15Minute">
                <gml:description>Average wind speed - 15 minutes</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:AverageWindSpeed15Minute</gml:identifier>
                <gml:name>AverageWindSpeed15Minute</gml:name>
                <swe:base xlink:href="#WindSpeed"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">TimeAverage</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">900</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="AverageAirTemperature15Minute">
                <gml:description>Average air temperature - 15 minutes</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:AverageAirTemperature15Minute</gml:identifier>
                <gml:name>AverageAirTemperature15Minute</gml:name>
                <swe:base xlink:href="#AirTemperature"/>
                <!-- trying to represent the averaging period in secconds -->
```

```
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">TimeAverage</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">900</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="MaximumWindSpeed15Minute">
                <gml:description>Maximum wind speed - 15 minutes</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MaximumWindSpeed15Minute</gml:identifier>
                <gml:name>MaximumWindSpeed15Minute</gml:name>
                <swe:base xlink:href="#WindSpeed"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Max</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">900</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="MinimumWindSpeed15Minute">
                <gml:description>Minimum wind speed - 15 minutes</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MinimumWindSpeed15Minute</gml:identifier>
                <gml:name>MinimumWindSpeed15Minute</gml:name>
                <swe:base xlink:href="#WindSpeed"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Min</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">900</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:ConstrainedPhenomenon gml:id="MaximumRelativeHumidity15Minute">
                <gml:description>Maximum relative humidity - 15 minutes</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:MaximumRelativeHumidity15Minute</gml:identifier>
                <gml:name>MaximumRelativeHumidity15Minute</gml:name>
                <swe:base xlink:href="#RelativeHumidity"/>
                <!-- trying to represent the averaging period in secconds -->
                <swe:singleConstraint>
                    <swe:TypedValue>
                        <swe:property codeSpace="./">Max</swe:property>
                        <swe:value xsi:type="gml:MeasureType" uom="./units.xml#s">900</swe:value>
                    </swe:TypedValue>
                </swe:singleConstraint>
            </swe:ConstrainedPhenomenon>
        </gml:dictionaryEntry>
        <!-- Some odds and sods for illustrative purposes -->
        <gml:dictionaryEntry>
            <swe:Phenomenon gml:id="Weather">
                <gml:description>Generic weather type. This may be used directly, typically for cases where the
observation has a textual result. Or it may serve as the basis for more specific weather types by extension - see
below.</gml:description>
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:OGC:Weather</gml:identifier>
                <gml:name>Weather</gml:name>
            </swe:Phenomenon>
        </gml:dictionaryEntry>
        <gml:dictionaryEntry>
            <swe:CompositePhenomenon gml:id="weather1" dimension="6">
                <gml:identifier codeSpace="urn:x-ogc:tc:arch:doc-rp(05-010)">urn:x-
ogc:def:phenomenon:SEEGrid:weather1</gml:identifier>
```

```
            <swe:base xlink:href="urn:x-ogc:def:phenomenon:OGC:Weather"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:AirTemperature"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:WindSpeed"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:WindDirection"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:AtmosphericPressure"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:RelativeHumidity"/>
            <swe:component xlink:href="urn:x-ogc:def:phenomenon:OGC:Visibility"/>
        </swe:CompositePhenomenon>
    </gml:dictionaryEntry>
</gml:Dictionary>
```

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