Proposed change affects: ✓  AS □ Imp Spec X  Best Practices Paper □ Other □

Title: ✓  Move XML implementation of Observation Schema Extensions to separate namespace

Source: ✓  CSIRO

Work item code: ✓  CR08-022

Date: ✓  25 February 2008

Category: ✓  F

Use one of the following categories:

F  (Critical correction)  
A  (corresponds to a correction in an earlier release)  
B  (Addition of feature),  
C  (Functional modification of feature)  
D  (Editorial modification)  

Detailed explanations of the above categories can be found in the TC Policies and Procedures.

Reason for change: ✓  The XML Schema implementation of optional/informative elements of the Observation Schema was published in the om/1.0.0/extension directory, in the same XML namespace as the base schema. Those OGC implementations that have a dependency on the Observation Schema (i.e. Sampling Features, SOS) <import> the “all-components” document om.xsd. However, the all-components stub-schema document “om.xsd” does not include the extensions. Thus, any application which requires one of the dependent OGC schemas (Sampling Features, SOS) may not access the Observation Schema Extensions, since the <import> of om.xsd clashes with any attempt to <import> om_extended.xsd. This problem is a consequence of an error in the modularization strategy for optional elements, combined with the rules for schema document resolution used by standard processing environments.

Summary of change: ✓  1. move the Observation Schema Extensions components to a new namespace  
2. rearrange Annex D to reflect refactoring  
3. correct one example in Annex E  
4. minor corrections to namespaces and schemaLocation paths  
5. republish om/1.0.0/extensions as omx/1.0.0 in the OGC schema repository

Note: this change has NO EFFECT on the published Observation Schema, as reflected by
the standard “all-components” stub schema imported by external applications.

<table>
<thead>
<tr>
<th>Consequences if not approved:</th>
<th>Observation Schema Extensions are not available to applications that also have Sampling Features or SOS as dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consequences if not approved:</strong></td>
<td>Annex D, Annex E 3.2</td>
</tr>
<tr>
<td><strong>Other specs Affected:</strong></td>
<td>Other core specifications</td>
</tr>
<tr>
<td><strong>Supporting Doc.</strong></td>
<td>Abstract specifications</td>
</tr>
<tr>
<td><strong>Other comments:</strong></td>
<td>Best Practices Document</td>
</tr>
<tr>
<td><strong>Material below provides drop-in replacements for Annex D and Annex E</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Status:**

**Disposition:**
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.

Note that the XML Schema presented in this Annex uses GML 3.1.1. This is the GML version used by SensorML v1.0 and by the SWE Common v1.0 components described therein, which are used by the O&M encoding. Schema validity of a set of dependent XML schemas requires that they use common versions.

2 Observation Schema schema

2.1 Namespace

The XML schema for Observation Schema v1.0 is in the namespace
http://www.opengis.net/om/1.0

2.2 Dependencies

The Observation Schema v1.0 has direct dependencies on the following externally governed schemas:

<table>
<thead>
<tr>
<th>Schema</th>
<th>Version</th>
<th>XML namespace</th>
<th>Location of imported schema document</th>
</tr>
</thead>
<tbody>
<tr>
<td>GML</td>
<td>3.1.1</td>
<td><a href="http://www.opengis.net/gml">http://www.opengis.net/gml</a></td>
<td><a href="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">http://schemas.opengis.net/gml/3.1.1/base/gml.xsd</a></td>
</tr>
<tr>
<td>Swe Common</td>
<td>1.0.1</td>
<td><a href="http://www.opengis.net.swe/1.0.1">http://www.opengis.net.swe/1.0.1</a></td>
<td><a href="http://schemas.opengis.net/swe/1.0.1/swe.xsd">http://schemas.opengis.net/swe/1.0.1/swe.xsd</a></td>
</tr>
<tr>
<td>SensorML</td>
<td>1.0.1</td>
<td><a href="http://www.opengis.net/sensorML/1.0.1">http://www.opengis.net/sensorML/1.0.1</a></td>
<td><a href="http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd">http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd</a></td>
</tr>
</tbody>
</table>

**Issue:** The ISO 19115 Metadata XML Implementation described in ISO 19139 is bound to GML 3.2, so cannot be used with this version. Placeholder types and elements have
been used in place of the ISO components in this version of the schema. The upgrade path is indicated at relevant points in the schema documents.

**Issue:** It has been suggested that the concrete observation feature-type provided as part of GML (viz. gml:Observation) might be replaced by om:Observation. Since om:Observation has dependencies on SWE Common and on SensorML, this would require either (i) that those dependencies were also introduced into GML, (ii) that the content-model be relaxed to take a wild-card (<any> or type="xs:anyType") in place of SWE Common or SensorML components, or (iii) that the observation feature-type be removed from GML, and application developers directed to O&M as a standard cross-domain application schema for Observations, but not in the GML namespace.

2.3 Observation

This document implements the basic Observation and ObservationCollection classes described in sub-clause 6.2 and shown in Figure 2.

Listing 1. observation.xsd

```xml
<?xml version="1.0" encoding="UTF-8"?>
xmlns:om="http://www.opengis.net/om/1.0"
xmlns:swe="http://www.opengis.net/swe/1.0.1" xmlns:sml="http://www.opengis.net/sensorML/1.0.1"
targetNamespace="http://www.opengis.net/om/1.0" elementFormDefault="qualified" attributeFormDefault="unqualified"
version="1.0.0">
<annotation>
<documentation>observation.xsd An XML implementation of the O&M model from OGC 07-022</documentation>
</annotation>
<import namespace="http://www.opengis.net/gml" schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
<import namespace="http://www.isotc211.org/2005/gmd" schemaLocation="../../gml/trunk/gml/3.1.1/gmd/gmd.xsd"/>
<import namespace="http://www.opengis.net/swe/1.0.1" schemaLocation="http://schemas.opengis.net/swe/1.0.1/swe.xsd"/>
<import namespace="http://www.opengis.net/sensorML/1.0.1" schemaLocation="http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd"/>
<complexType name="ObservationType">
<annotation>
<documentation>Base type for Observations. Observation is an act ("event"), whose result is an estimate of the value of a property of the feature of interest. The observed property may be any property associated with the type of the feature of interest. The following properties are inherited from AbstractFeatureType:
</documentation>
</annotation>
<complexContent>
<extension base="gml:AbstractFeatureType">
<element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
<element ref="gml:description" minOccurs="0" maxOccurs="unbounded"/>
<element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>
<element ref="gml:boundedBy" minOccurs="0" maxOccurs="unbounded"/>
</extension>
</complexContent>
</complexType>
</schema>
```

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Example: Where sensor observation results are post-processed, the resultTime is the post-processing time, while the samplingTime preserves the time of initial interaction with the world.

Example: Simulations are often used to estimate the values for phenomena in the future or past.

Example: Where sensor observation results are post-processed, the resultTime is the post-processing time, while the samplingTime preserves the time of initial interaction with the world.

Example: Where sensor observation results are post-processed, the resultTime is the post-processing time, while the samplingTime preserves the time of initial interaction with the world.
This will typically be used to record environmental parameters, or event-specific sampling parameters that are not tightly bound to either the feature-of-interest or the procedure.

NOTE: Parameters that are tightly bound to the procedure should be recorded as part of the procedure description. For example, the SensorML model associates parameters with specific process elements or stages.

NOTE: The semantics of the parameter must be provided as part of its value.

In some applications it is convenient to use a generic or standard procedure, or feature-of-interest, rather than define an event-specific process or feature.

In this context, event-specific parameters are bound to the Observation act.

The type of the observation result must be consistent with the observed property, and the scale or scope of the value must be consistent with the quantity or category type.

Application profiles may choose to constrain the type of the result.

The observed property may be any property associated with the type of the feature of interest.

The result contains the value generated by the procedure.

Application profiles may choose to constrain the type of the result.

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<annotation>This element is xs:anyType so may contain a description of a process provided in any well-formed XML. If the process description is namespace qualified, then the namespace must be identified in the instance document.</annotation>

<complexType>
<!DOCTYPE --
--======================================================================-->
<!DOCTYPE --=============================================================-->
<complexType name="AnyOrReferenceType">
<annotation>
<documentation>Placeholder type
Used in a few places where ISO 19139 metadata classes are used, which will become available with GML</documentation>
<annotation>
<sequence minOccurs="0">
<any/>
</sequence>
<attributeGroup ref="gml:AssociationAttributeGroup"/>
</complexType>
<!DOCTYPE --
--======================================================================-->
<!DOCTYPE --=============================================================-->
</schema>

2.4 Schema for import

Listing 2 is a stub schema document that collects Observation Schema components for use in external domain schemas. Use of this document in for external references to the Observation schema package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 2.  om.xsd

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:om="http://www.opengis.net/om/0.0" targetNamespace="http://www.opengis.net/om/0.0" elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.0">
<annotation>
<documentation>om.xsd
The complete Observations and Measurements schema
Copyright © 2007 Open Geospatial Consortium - see http://www.opengeospatial.org/about/?page=ipr</documentation>
</annotation>
<!--
--======================================================================-->
<include schemaLocation="/observation.xsd"/>
<!--
--======================================================================-->
</schema>

3 Observation Schema Extensions schema

3.1 Namespace

The XML schema for Observation Schema Extensions v1.0 is in the namespace http://www.opengis.net/omx/1.0
3.2 Dependencies

The Observation Schema Extensions schema v1.0 has direct dependencies on the following externally governed schemas:

<table>
<thead>
<tr>
<th>Schema</th>
<th>Version</th>
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<td><a href="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">http://schemas.opengis.net/gml/3.1.1/base/gml.xsd</a></td>
</tr>
<tr>
<td>Swe Common</td>
<td>1.0.1</td>
<td><a href="http://www.opengis.net/swe/1.0.1">http://www.opengis.net/swe/1.0.1</a></td>
<td><a href="http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd">http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd</a></td>
</tr>
<tr>
<td>SensorML</td>
<td>1.0.1</td>
<td><a href="http://www.opengis.net/sensorML/1.0.1">http://www.opengis.net/sensorML/1.0.1</a></td>
<td><a href="http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd">http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd</a></td>
</tr>
<tr>
<td>O&amp;M</td>
<td>1.0.0</td>
<td><a href="http://www.opengis.net/om/1.0.0">http://www.opengis.net/om/1.0.0</a></td>
<td><a href="http://schemas.opengis.net/om/1.0.0/om.xsd">http://schemas.opengis.net/om/1.0.0/om.xsd</a></td>
</tr>
<tr>
<td>Discrete coverages</td>
<td>0.2.1</td>
<td><a href="http://www.opengis.net/cv/0.2.1">http://www.opengis.net/cv/0.2.1</a></td>
<td><a href="http://bp.schemas.opengis.net/06-188r1/cv/0.2.1/cv.xsd">http://bp.schemas.opengis.net/06-188r1/cv/0.2.1/cv.xsd</a></td>
</tr>
</tbody>
</table>

3.3 Specialized observation

Listing 3 implements the specialized Observation classes described in sub-clause 6.3.3.2, and shown in Figure 3. Specialization is accomplished using Schematron [ISO/IEC 19737-3] constraints to enforce the result type.

NOTE: In earlier versions specialized observations were implemented in the same namespace as the generic observation schema, using W3C XML Schema restriction and redefine elements. In this implementation, the specializations have been refactored into a separate namespace, to aid implementation using standard XML processors.

Listing 3. observationSpecialization.xsd

```xml
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:om="http://www.opengis.net/om" targetNamespace="http://www.opengis.net/omx/1.0" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0.0">
  <annotation>
    <appinfo source="urn:ogc:specification:om:doc-is(07-022r3):1.0.0">
      <sch:title>Schematron validation</sch:title>
      <sch:prefix="gml" url="http://www.opengis.net/gml"/>
      <sch:prefix="om" url="http://www.opengis.net/om"/>
      <sch:prefix="omx" url="http://www.opengis.net/omx/1.0"/>
      <sch:prefix="swe" url="http://www.opengis.net/swe/1.0.1"/>
      <sch:prefix="xs" url="http://www.w3.org/2001/XMLSchema-instance"/>
    </appinfo>
  </annotation>
  <documentation>observationSpecialization.xsd</documentation>
</schema>
```

An implementation of the O&M model for SWE.

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

The specialization is achieved by using Schematron to constrain the type of the result element from om:ObservationType.

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<element name="Measurement" type="om:ObservationType" substitutionGroup="om:Observation">  
  <annotation>  
    <appinfo>
    </appinfo>
  </annotation>
  <sch:pattern name="result type must be gml:MeasureType">  
    <sch:rule context="/om:Measurement">
      <sch:assert test="om:result/@xsi:type='gml:MeasureType' ">xsi:Type must be gml:MeasureType</sch:assert>
    </sch:rule>
  </sch:pattern>
</element>

<!-- bring in other schemas -->

<option name="http://www.opengis.net/gml"  
  schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>

<option name="http://www.opengis.net/swe"  
  schemaLocation="http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd"/>

<option name="http://www.opengis.net/om"  
  schemaLocation="http://schemas.opengis.net/om/1.0"/>

<!-- Import GML Schema -->
<import namespace="http://www.opengis.net/gml"  
  schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
<import namespace="http://www.opengis.net/swe"  
  schemaLocation="http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd"/>
<import namespace="http://www.opengis.net/om"  
  schemaLocation="http://schemas.opengis.net/om/1.0"/>

<!-- ====== Scalar Observations ====== -->

<!-- Specialized Observation in which the result is a Measure -->

<!-- Specialized Observation, in which the result is a textual value from a controlled vocabulary -->

<!-- Specialized Observation, in which the result is an integer representing the count of the observed property -->

<!-- Specialized Observation, in which the result is a boolean value representing the truth value (usually existence) of the observed property -->

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Specialized Observation, in which the result is a geometry

```
<element name="TemporalObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <sch:rule name="result must contain a gml:TimeObject and nothing else">
    <sch:pattern context="/omx:TemporalObservation">
      <gml:assert test="om:result/@xsi:type='gml:TimePrimitivePropertyType' " xsi:Type of the result element must be gml:TimePrimitivePropertyType
    </sch:pattern>
  </sch:rule>
</element>
```

```
<element name="ComplexObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <sch:rule name="result must contain a swe:DataRecord and nothing else">
    <sch:pattern context="/omx:ComplexObservation">
      <swe:DataRecord must be present as child of
    </sch:pattern>
  </sch:rule>
</element>
```

3.4 Coverage observation types

Listing 4 and Listing 5 implement the specialized observation types with coverage results described in 6.3.3.3 and Figure 3. The Observation result is constrained to be from the Discrete Coverages schema (OGC 06-188r1).

**Listing 4.** observationCoverage.xsd

```
<annotation>
  <appinfo>
    Specialized Observation, in which the result is a geometry
  </appinfo>
</annotation>
```

```
<element name="TemporalObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <sch:pattern name="result must contain a gml:TimeObject and nothing else">
    <sch:rule context="/omx:TemporalObservation">
      <gml:assert test="om:result/@xsi:type='gml:TimePrimitivePropertyType' " xsi:Type of the result element must be gml:TimePrimitivePropertyType
    </sch:pattern>
  </sch:rule>
</element>
```

```
<element name="ComplexObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <sch:pattern name="result must contain a swe:DataRecord and nothing else">
    <sch:rule context="/omx:ComplexObservation">
      <swe:DataRecord must be present as child of
    </sch:pattern>
  </sch:rule>
</element>
```

An implementation of the OandM model for SWE.

This document contains specializations of the basic observation pattern, fixing the type of the result to be various discrete
coverage types.

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<annotation>
  <!-- ...
  <import namespace="http://www.opengis.net/cv/0.2.1" schemaLocation="http://bp.schemas.opengis.net/06-188r1/cv/0.2.1/cv.xsd"/>
  <import namespace="http://www.opengis.net/om/1.0" schemaLocation="http://schemas.opengis.net/om/1.0.0/om.xsd"/>
  <documentation>...</documentation>
  <appinfo><sch:pattern name="result must contain a cv:CV_DiscreteCoverage and nothing else">
    <sch:rule context="/om:DiscreteCoverageObservation">
      <sch:assert test="om:result/cv:CV_DiscreteCoverage">cv:CV_DiscreteCoverage must be present as child of om:result</sch:assert>
    </sch:rule>
    </sch:pattern>
  </appinfo>
  <documentation>Specialized Observation, in which the result is a generalized discrete coverage</documentation>
</annotation>

<element name="DiscreteCoverageObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <annotation>
    <appinfo>
      <sch:pattern name="result must contain a cv:CV_DiscretePointCoverage and nothing else">
        <sch:rule context="/om:PointCoverageObservation">
          <sch:assert test="om:result/cv:CV_DiscretePointCoverage">cv:CV_DiscretePointCoverage must be present as child of om:result</sch:assert>
        </sch:rule>
        </sch:pattern>
    </appinfo>
    <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>

<element name="TimeSeriesObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <annotation>
    <appinfo>
      <sch:pattern name="result must contain a cv:CV_DiscreteTimeInstantCoverage and nothing else">
        <sch:rule context="/om:TimeSeriesObservation">
          <sch:assert test="om:result/cv:CV_DiscreteTimeInstantCoverage">cv:CV_DiscreteTimeInstantCoverage must be present as child of om:result</sch:assert>
        </sch:rule>
        </sch:pattern>
    </appinfo>
    <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>

<element name="ElementCoverageObservation" type="om:ObservationType" substitutionGroup="om:Observation">
  <annotation>
    <appinfo>
      <sch:pattern name="result must contain a cv:CV_DiscreteElementCoverage and nothing else">
        <sch:rule context="/om:ElementCoverageObservation">
          <sch:assert test="om:result/cv:CV_DiscreteElementCoverage">cv:CV_DiscreteElementCoverage must be present as child of om:result</sch:assert>
        </sch:rule>
        </sch:pattern>
    </appinfo>
    <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
  </annotation>
</element>
Listing 5.  observationCoverageCompact.xsd

An implementation of the OandM model for SWE
This document contains specializations of the basic observation pattern, fixing the type of the result to be various discrete coverage types (compact version).

In this schema, the derivation model is "**restriction**"

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<annotation>
  <appinfo source="urn:ogc:specification:om:doc-is(07-022r3):1.0.0">
    <sch:title>Schematron validation</sch:title>
    <sch:ns prefix="omx" url="http://www.opengis.net/omx/1.0"/>
    <sch:ns prefix="om" url="http://www.opengis.net/om/1.0"/>
    <sch:ns prefix="cv" url="http://www.opengis.net/cv/0.2.1"/>
  </appinfo>
</annotation>
<documentation>observationCoverageCompact.xsd</documentation>

<schema xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:cv="http://www.opengis.net/cv/0.2.1"
  xmlns:om="http://www.opengis.net/om/1.0"
  xmlns:omx="http://www.opengis.net/omx/1.0"
  targetNamespace="http://www.opengis.net/omx/1.0"
  elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0.0">
  <annotation>
    <appinfo source="urn:ogc:specification:om:doc-is(07-022r3):1.0.0">
      <sch:title>Schematron validation</sch:title>
      <sch:ns prefix="omx" url="http://www.opengis.net/omx/1.0"/>
      <sch:ns prefix="om" url="http://www.opengis.net/om/1.0"/>
      <sch:ns prefix="cv" url="http://www.opengis.net/cv/0.2.1"/>
    </appinfo>
  </annotation>
  <documentation>observationCoverageCompact.xsd</documentation>

  <!-- bring in other schemas -->
  <import namespace="http://www.opengis.net/cv/0.2.1" schemaLocation="http://bp.schemas.opengis.net/06-18Br1/cv/0.2.1/cv.xsd"/>
  <import namespace="http://www.opengis.net/omx/1.0" schemaLocation="http://schemas.opengis.net/om/1.0.0/om.xsd"/>

  <!-- === Compact coverage observations = implement the "geometry" element in the result in compact form === -->
  <element name="DiscreteCoverageObs" type="om:ObservationType" substitutionGroup="om:Observation">
    <annotation>
      <appinfo>
        <sch:pattern name="result must contain a cv:CompactDiscreteCoverage and nothing else">
          <sch:rule context="/omx:DiscreteCoverageObs">
            <sch:assert test="om:result/cv:CompactDiscreteCoverage">
              cv:CompactDiscreteCoverage must be present as child of om:result
              <sch:assert test="count(om:result/*) = 1">
                one and only one child element must be present</sch:assert>
            </sch:assert>
          </sch:rule>
        </sch:pattern>
      </appinfo>
    </annotation>
  </element>
</schema>
3.5 Observation processes

Listing 6 implements the simple model for ObservationProcess shown in Figure 1, which specializes the SensorML Process by adding a property to denote a well-known method and also the expected quality of results from that method. This may be used to denote a procedure when the full detail available through SensorML is not required.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:om="http://www.opengis.net/om/1.0"
        xmlns:omx="http://www.opengis.net/omx/1.0"
        xmlns:sml="http://www.opengis.net/sensorML/1.0.1"
        xmlns:gml="http://www.opengis.net/gml"
        targetNamespace="http://www.opengis.net/omx/1.0"
        elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0.0">

<annotation>
<element name="TimeSeriesObs" type="om:ObservationType" substitutionGroup="om:Observation">
  <annotation>
    <appinfo>
      <sch:pattern name="result must contain a cv:CompactDiscreteTimeCoverage and nothing else">
        <sch:rule context="/omx:TimeSeriesObs">
          <sch:assert test="/om:result/cv:CompactDiscreteTimeCoverage">
            cv:CompactDiscreteTimeCoverage must be present as child of om:result
          </sch:assert>
        </sch:rule>
        <sch:assert test="count(om:result/*) = 1">
          one and only one child element must be present
        </sch:assert>
      </sch:pattern>
    </appinfo>
  </annotation>
</element>
</schema>
```

**Figure 1. Simple model for Observation Processes**
Components to describe procedures used in observations and measurements, and other events.

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<complexType name="ObservationProcessPropertyType">
    <documentation>Head of substitution group of observation procedures. Use gml:description element to describe the procedure or link to a definitive description.</documentation>
    <element name="resultQuality" type="om:QualificationPropertyType" minOccurs="0"/>
</complexType>

<complexType name="InstrumentType">
    <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>
</complexType>

<complexType name="ObservationProcessType">
    <documentation>Head of substitution group of observation procedures. Use gml:description element to describe the procedure or link to a definitive description.</documentation>
</complexType>

<element name="ObservationProcess" type="om:ObservationProcessType" substitutionGroup="sml:_Process">
    <sequence minOccurs="0">
        <element ref="om:ObservationProcess"/>
    </sequence>
</element>

<element name="Instrument" type="om:InstrumentType" substitutionGroup="om:ObservationProcess">
</element>

<element name="resultQuality" type="gmd:DQ_Element_PropertyType" minOccurs="0">
    <documentation>Code for the particular procedure type. Usually an item from a list or register of procedures, methods, instrument-types, etc. </documentation>
</element>

<element name="resultQuality" type="gmd:DQ_Element_PropertyType" minOccurs="0">
    <documentation>Quality associated systematically with observations made using this procedure.</documentation>
</element>

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Use gml:description element to describe the procedure or link to a definitive description.</documentation>
</annotation>
<!-------------------------- -->
<complexType name="InstrumentPropertyType">
  <sequence minOccurs="0">
    <element ref="omx:Instrument"/>
  </sequence>
  <attributeGroup ref="gml:AssociationAttributeGroup"/>
</complexType>
<!-------------------------- -->
<complexType name="CalculationProcessType">
  <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="omx:ObservationProcessType"/>
  </complexContent>
</complexType>

3.6 Schema for import

Listing 7 is a stub schema document that collects the Observation Schema Extensions components for use in external domain schemas. Use of this document in for external references to the Observation Schema Extensions package ensures that all components are included, and reduces the risk of conflicting <import> statements.

Listing 7. om_extended.xsd

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" targetNamespace="http://www.opengis.net/omx/1.0" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0.0">
  <annotation>
    <documentation>om_extended.xsd
    The Observation Schema Extensions schema. This document includes the
    * the extensions to define specialized observations with constrained result types
    * specialized procedure types
    * coverage-observations
    Copyright (c) 2007,2008 Open Geospatial Consortium - see
    http://www.opengeospatial.org/ogc/software</documentation>
  </annotation>
  <include schemaLocation="/observationSpecialization.xsd"/>
  <include schemaLocation="/observationCoverage.xsd"/>
  <include schemaLocation="/observationCoverageCompact.xsd"/>
  <include schemaLocation="/procedureSpecialization.xsd"/>
</schema>
ANNEX E
(informative)

XML implementation - examples

1 Introduction

The details of the XML implementation may be explored using instance examples. Using
the GML implementation rules results in an explicit mapping from the model, using
names from the model as element and attribute names. 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 some 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 record structure is indicated separately.

2 Coding standards

2.1 Dependencies

The instance examples in this clause depend on the following externally governed
schemas:

<table>
<thead>
<tr>
<th>Schema</th>
<th>Version</th>
<th>XML namespace</th>
<th>Location of imported schema document</th>
</tr>
</thead>
<tbody>
<tr>
<td>GML</td>
<td>3.1.1</td>
<td><a href="http://www.opengis.net/gml">http://www.opengis.net/gml</a></td>
<td><a href="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">http://schemas.opengis.net/gml/3.1.1/base/gml.xsd</a></td>
</tr>
<tr>
<td>Swe</td>
<td>1.0.1</td>
<td><a href="http://www.opengis.net.swe/1.0.1">http://www.opengis.net.swe/1.0.1</a></td>
<td><a href="http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd">http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd</a></td>
</tr>
</tbody>
</table>
3 Simple Observations with scalar results

3.1 Measurements

The document shown in Listing 8 describes a simple observation to determine the mass of a specific banana.

The value of the procedure (“scales”), the observedProperty (“mass”), and the featureOfInterest (a fruit) 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.

Listing 8. observation1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?><om:Observation gml:id="obsTest1"
xmlns:om="http://www.opengis.net/om/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmns:xlink="http://www.w3.org/1999/xlink"
xmns:gml="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd"
<gml:description>Observation test instance: fruit mass</gml:description>
<gml:name>Observation test 1</gml:name>
<om:samplingTime>
  <gml:timeInstant gml:id="ot1t">
  </gml:timeInstant>
</om:samplingTime>
<om:procedure xlink:href="http://www.flakey.org/register/process/scales34.xml"/>
<!-- a notional URL identifying a procedure ... -->
<om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:mass"/>
```
3.2 Category observations

The document shown in Listing 9 describes a simple observation to determine the species of an item of market produce.

The observedProperty ("species") and feature of interest 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 description of the procedure is encapsulated using SensorML.

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.

Listing 9. observation2.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation xmlns:om="http://www.opengis.net/om/1.0"
xmlns:sml="http://www.opengis.net/sensorML/1.0.1"
xmlns:swe="http://www.opengis.net/swe/1.0.1"
xmlns:xlink="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsi:schemalocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd"
xmlns:xlink:schemalocation="http://www.opengis.net/sensorML/1.0 http://schemas.opengis.net/sensorML/1.0.0/sensorML.xsd">
  <gml:description>Observation test instance: fruit identification</gml:description>
  <gml:name>Observation test 2</gml:name>
  <gml:samplingTime>
</gml:samplingTime>
  <om:observedProperty xlink:href="http://eprint.iupui.edu/17182"/>
  <om:result xsi:type="swe:ScopedNameType" codeSpace="http://en.wikipedia.org/wiki/List_of_fruits">Banana</om:result>
</om:Observation>
```

The document shown in Listing 10 describes the same observation except that this time the description of the procedure is encapsulated in the om:Process element, which provides a generic container for components from any namespace, thus allowing re-use of a pre-existing schema for observation methods.
Listing 10.  observation2b.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <om:featureOfInterest xlink:href="http://wfs.flakey.org?request=getFeature&featureid=fruit37f" />
  <om:result xsi:type="swe:ScopedNameType">
    <swe:displayName codeSpace="http://en.wikipedia.org/wiki/List_of_fruits" code="Banana" />
  </om:result>
</om:Observation>
```

The document shown in Listing 11 describes the same observation using the specialized observation type CategoryObservation taken from the Observation Schema Extensions schema shown in ANNEX D sub-clause 3.

Listing 11.  observation2c.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<omx:result xsi:type="swe:ScopedNameType">
  <swe:displayName codeSpace="http://en.wikipedia.org/wiki/List_of_fruits" code="Banana" />
</omx:result>
</omx:CategoryObservation>
```

3.3 Observation of a complex property

The document shown in Listing 12 describes an observation of the shape of a banana.

This has the following differences compared to the previous examples: (a) the procedure is identified as “triangulation987” (b) a resultTime is also given, indicating the time when the triangulation procedure was applied, which in this case was the day following when
the item of fruit was actually obtained (c) the observed property is “Shape” and (d) 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. The result is an XML encoded data structure, using a sub-element whose name is explicit, so no xsi:type attribute is required.

Listing 12. observation2shape.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="shapeTest2"
xmlns:om="http://www.opengis.net/om/1.0"
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.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd">
  <gml:description>Observation test instance</gml:description>
  <gml:name>Shape observation test</gml:name>
  <om:samplingTime>
    <gml:TimeInstant gml:id="ot2t">
    </gml:TimeInstant>
  </om:samplingTime>
  <om:resultTime>
    <gml:TimeInstant gml:id="ot2ts">
      <gml:timePosition>2005-01-12T09:25:00.00</gml:timePosition>
    </gml:TimeInstant>
  </om:resultTime>
  <om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:Shape"/>
  <om:result>
    <gml:Solid gml:id="bs">
      <gml:description>An explicit description of a solid. The details of the description of the exterior surface omitted here for brevity.</gml:description>
      <gml:exterior>
        <gml:Surface gml:id="be">
          <!-- omissions suppressed for brevity -->
        </gml:Surface>
      </gml:exterior>
    </gml:Solid>
  </om:result>
</om:Observation>
```

4 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 13 describes an observation of Relative Humidity at an observation station.

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.

**Listing 13.** pointer1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="OPTest1"
xmlns:om="http://www.opengeospatial.net/om/1.0"
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.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd">
  <gml:description>Observation instance with remote result</gml:description>
  <gml:name>Observation Pointer 1</gml:name>
  <om:samplingTime>
    <gml:TimePeriod xlink:href="#op1t">
    </gml:TimePeriod>
  </om:samplingTime>
  <om:observedProperty xlink:href="urn:o-ogc:def:phenomenon:OGC:RelativeHumidity"/>
</om:Observation>
```

The document shown in Listing 14 describes an observation of “Stress” in a shallow borehole.

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.

**Listing 14.** pointer2.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="OPTest2"
xmlns:om="http://www.opengeospatial.net/om/1.0"
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.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd">
  <gml:description>Observation instance with remote result</gml:description>
  <gml:name>Observation Pointer 2</gml:name>
  <om:samplingTime>
    <gml:TimePeriod xlink:href="#op1t">
    </gml:TimePeriod>
  </om:samplingTime>
  <om:observedProperty xlink:href="urn:o-ogc:def:phenomenon:SEEGrid:stress"/>
  <om:result xlink:href="http://some.datasupplying.org/results%3798002%26property=stress" xlink:role="application/xml" xlink:type="gml:ReferenceType"/>
</om:Observation>
```
5 Compound observations

5.1 Observation Collection

The document shown in Listing 15 describes a collection of two observations.

```
Listing 15.  Collection1.xml

<?xml version="1.0" encoding="UTF-8"?>
<om:ObservationCollection gml:id="coll1"
xmlns:om="http://www.opengis.net/om/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xlink:xref="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml"
xsd:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd">
    <gml:description>Collection of observations</gml:description>
    <gml:name>Observation Collection 1</gml:name>
    <om:member>
        <om:Observation gml:id="o1">
            <om:samplingTime>
                <gml:TimeInstant gml:id="ot1t">
                </gml:TimeInstant>
            </om:samplingTime>
            <om:procedure xlink:href="http://www.flakey.org/register/process/scales34.xml"/>
            <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:samplingTime>
                <gml:TimeInstant gml:id="ot2t">
                    <gml:timePosition>2005-01-11T17:24:25.00</gml:timePosition>
                </gml:TimeInstant>
            </om:samplingTime>
            <om:procedure xlink:href="http://www.flakey.org/register/process/scales34.xml"/>
            <om:result xsi:type="gml:MeasureType" uom="urn:x-ogc:def:uom:OGC:kg">0.27</om:result>
        </om:Observation>
    </om:member>
</om:ObservationCollection>
```

5.2 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 16 the result is given as a swe:Record, which separates the components fields encoded in generic XML elements. The feature of interest is 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 property type definitions, the content of which is shown in Listing 17. The RS gives a link to a description of the result structure, shown as a swe:DataRecord in Listing 18.

```
Listing 16.  complexObservation3.xml

<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="COTest3" xmlns:om="http://www.opengis.net/om/1.0"
```

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The document shown in Listing 17 shows a property type description composed of six elements, given as links to concepts identified by URN. The base property type (“Weather”) allows this specialized definition (“weather1”) to be related to its parent. The parent property type may be used by some interfaces to allow discovery of related offerings.

### Listing 17. weather1.xml

```xml
<?xml version="1.0"?>
<swe:CompositePhenomenon
  xmlns:swe="http://www.opengis.net/swe/1.0.1"
  xmlns:gml="http://www.opengis.net/gml"
  xsi:schemaLocation="http://www.opengis.net/swe/1.0.1 http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd" gml:id="weather1" dimension="6">
</swe:CompositePhenomenon>
```

The document shown in Listing 18 shows a record-type description composed of six elements, matching the property type description given above. Each field description binds a representation to a presentation (the name of the component child element – i.e. *Quantity, Category*) and a scale (the value of the *uom* attribute).

Note that this element plays a different but complementary role: the property type description is primarily concerned with semantics, and would be used for *discovery*; the record description is primarily concerned with data structure, and would be used for *exploitation*.
Listing 18.  weatherRecord1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <swe:field name="AirTemperature">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:AirTemperature">
      </swe:Quantity>
  </swe:field>
  <swe:field name="WindSpeed">
      <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:m_s"/>
      </swe:Quantity>
  </swe:field>
  <swe:field name="WindDirection">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:WindDirectionToNorth">
      </swe:Quantity>
  </swe:field>
  <swe:field name="AtmosphericPressure">
    <swe:Quantity definition="http://sweet.jpl.nasa.gov/ontology/property.owl#AtmosphericPressure">
      </swe:Quantity>
  </swe:field>
  <swe:field name="RelativeHumidity">
    <swe:Quantity definition="http://sweet.jpl.nasa.gov/ontology/property.owl#RelativeHumidity">
      </swe:Quantity>
  </swe:field>
  <swe:field name="Visibility">
    <swe:Category definition="http://sweet.jpl.nasa.gov/ontology/property.owl#Visibility">
      </swe:Category>
  </swe:field>
</swe:DataRecord>
```

5.3 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 19 and Listing 20 the observation is encoded using the generic Observation, with the result being a swe:CV_DiscreteCoverage. Listing 19 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 19.  multiElement1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <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:samplingTime>
```
Listing 20 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 20. multiElement2.xml

<?xml version="1.0" encoding="UTF-8"?>
<om:Observation gml:id="multi2" xmlns:cv="http://www.opengis.net/cv/0.2" xmlns:swe="http://www.opengis.net/swe/1.0.1" xmlns:om="http://www.opengis.net/om/1.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd http://www.opengis.net/cv/0.2 http://bp.schemas.opengis.net/06-188r1/cv/0.2.1/cv.xsd">
  <om:Result gml:id="ots1t">
    <gml:timePosition gml:id="ots1t">2005-06-17</gml:timePosition>
    <gml:samplingTime>
      <om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Radiance"/>
    </om:samplingTime>
    <om:Result>
      <cv:CV_DiscreteCoverage>
          <cv:rangeType xlink:href="urn:x-ogc:def:phenomenon:OGC:Radiance"/>
          <cv:element>
            <cv:CV_GeometryValuePair>
              <cv:geometry xlink:href="pixel1"/>
              <cv:value xsi:type="gml:MeasureType" uom="uV">10.1</cv:value>
            </cv:element>
          </cv:rangeType>
          <cv:element>
            <cv:CV_GeometryValuePair>
              <cv:geometry xlink:href="pixel2"/>
              <cv:value xsi:type="gml:MeasureType" uom="uV">15.7</cv:value>
            </cv:element>
          </cv:rangeType>
          <cv:element>
            <cv:CV_GeometryValuePair>
              <cv:geometry xlink:href="pixel3"/>
              <cv:value xsi:type="gml:MeasureType" uom="uV">20.2</cv:value>
            </cv:element>
          </cv:rangeType>
          <cv:element>
            <cv:CV_GeometryValuePair>
              <cv:geometry xlink:href="pixel4"/>
              <cv:value xsi:type="gml:MeasureType" uom="uV">27.5</cv:value>
            </cv:element>
          </cv:rangeType>
    </cv:CV_DiscreteCoverage>
  </om:Result>
</om:Observation>
The document fragment shown in Listing 21 describes a SamplingFeature which acts as the feature of interest for the observation shown in the previous listings. This feature type is from the sampling features schema described in O&M Part 2. The feature is composed of four Station members. The result of the observation supplies a value for each of these elements.

Listing 21.  foi.xml#stc1

```xml
<?xml version="1.0"?>
<foi:SamplingFeatureCollection xmlns:foi="http://www.opengis.net/sampling/1.0" xmlns:sa="http://www.opengis.net/sampling/1.0" xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/sampling/1.0 http://schemas.opengis.net/sampling/1.0.0/sampling.xsd" xmlns:ot2s="http://www.opengis.net/sampling/1.0" xsi:schemaLocation="http://www.opengis.net/sampling/1.0 http://schemas.opengis.net/sampling/1.0.0/sampling.xsd">
  <foi:description>This SamplingFeature serves as a container for a collection composed of a single Station and another SamplingFeature containing a collection of Stations</foi:description>
  <foi:Envelope srsName="urn:ogc:def:crs:EPSG:6.3:62836405">
    <foi:lowerCorner>-90 -180</foi:lowerCorner>
    <foi:upperCorner>90 180</foi:upperCorner>
  </foi:Envelope>
</foi:SamplingFeatureCollection>
```

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5.4 Time Series

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

The documents in this sub-clause describe an observation of a weather property at a station.
In Listing 22 rainfall is observed in a series of TimePeriods. The feature of interest is again indicated through links to elements in the site collection shown in Listing 21. The observation is encoded using the generic Observation.

In Listing 22 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 22.** timeSeries2.xml

```xml
<om:observedProperty xlink:href="urn:x-ogc:def:phenomenon:OGC:Precipitation"/>
<om:featureOfInterest xlink:href="http://my.big.org/feature?type=station%26name=st1"/>
<om:result>
  <cv:CV_DiscreteCoverage>
    <cv:domainExtent xlink:href="http://my.big.org/feature?type=station%26name=st1#boudnderBy")/>
    <cv:rangeType xlink:href="urn:x-ogc:def:phenomenon:OGC:Precipitation"/>
    <cv:element>
      <cv:CV_GeometryValuePair>
        <cv:geometry>
        </cv:geometry>
      </cv:element>
    </cv:element>
    <cv:CV_GeometryValuePair>
      <cv:geometry>
      </cv:geometry>
    </cv:element>
  </cv:CV_DiscreteCoverage>
</om:result>
```

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In Listing 23 air-temperature is observed at a series of time instants. The result is given as CompactDiscreteTimeCoverage. The domain objects are simple time positions. The range values are measures. An om:parameter is used to indicate that the actual sampling point is 3.5m above the station.

Listing 23.  timeSeries1.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation xlink:href="urn:x:station%26name=st1"
 xsi:schemaLocation="http://my.big.org/feature?type=station%26name=st1">
  <om:parameter>
      <gml:TimePeriod xlink:href="#ts1" xsi:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd http://www.opengis.net/cv/0.2.1 http://bp.schemas.opengis.net/06-188r1/cv/0.2.1/cv.xsd">
        <gml:beginPosition>2005-06-17T09:00:00+08:00</gml:beginPosition>
        <gml:endPosition>2005-06-21T09:00:00+08:00</gml:endPosition>
        <gml:duration>PT24H</gml:duration>
      </gml:TimePeriod>
    </om:samplingTime>
  </om:parameter>
</om:Observation>
```
In Listing 24 the same information is shown with the value of the result provided out-of-band, using the xlink pattern shown earlier.

Listing 24.  timeSeries1r.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation xlink:href="http://my.big.org/feature?type=station%26name=st1#xpointer(./boundedBy)"/>
<om:domainExtent xlink:href="http://my.big.org/feature?type=station%26name=st1#xpointer(./boundedBy)"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
<om:rangeType xlink:href="http://sweet.jpl.nasa.gov/ontology/property.owl#Temperature"/>
Listing 25 presents an observation whose result is a time-series of weather observations. The result is shown in compact form in a SWE Common “TextBlock”. The observed property definition was given earlier in Listing 17. In contrast to the previous examples, the result is not specifically tagged as a “coverage”. As the items in the swe:values element are not XML-tagged, use of the result requires that this be separately parsed, using the item separators indicated in the swe:encoding.

Listing 25.  weatherObservation.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<om:Observation xmlns="http://www.opengis.net/om/1.0" xmlns:gml="http://www.opengis.net/gml"
 xmlns:x:om="http://www.opengis.net/swe/1.0.1"
xsi:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd"/>
<om:result>Weather Data</om:result>
<om:samplingTime/>
<om:TimePeriod>
  <gml:beginPosition>2007-04-01T00:00:00.000-06:00</gml:beginPosition>
  <gml:endPosition>2007-04-01T03:40:00.000-06:00</gml:endPosition>
</om:TimePeriod>
<om:observedProperty xlink:href="weather1.xml"/>
<om:encoding/>
<swe:TextBlock decimalSeparator="." tokenSeparator=",” blockSeparator=" ”/>
<swe:values>
  2007-04-01T00:00:00.000-06:00,30.4,28.8,155.8,1055.32,55,haze
  2007-04-01T00:00:10.000-06:00,30.4,28.8,155.8,1055.4,59,haze
  2007-04-01T00:00:20.000-06:00,30.4,28.8,155.7,1055.47,65,haze
  2007-04-01T00:00:30.000-06:00,30.3,28.9,155.7,1055.55,66,haze
  2007-04-01T00:00:40.000-06:00,30.3,28.9,155.6,1055.62,61,haze
  2007-04-01T00:00:50.000-06:00,30.3,28.9,155.6,1055.69,55,haze
  2007-04-01T00:01:00.000-06:00,30.3,28.9,155.5,1055.77,51,haze
  2007-04-01T00:01:10.000-06:00,30.2,28.9,155.5,1055.84,48,haze
  2007-04-01T00:01:20.000-06:00,30.2,28.9,155.4,1055.91,43,haze
  2007-04-01T00:01:30.000-06:00,30.2,28.9,155.4,1055.99,44,haze
  2007-04-01T00:01:40.000-06:00,30.2,29,155.3,1056.06,46,haze
  2007-04-01T00:01:50.000-06:00,30.1,29,155.3,1056.13,48,haze
  2007-04-01T00:02:00.000-06:00,30.1,29,155.2,1056.24,42,haze
  2007-04-01T00:02:10.000-06:00,30.1,29,155.2,1056.27,41,haze
  2007-04-01T00:02:20.000-06:00,30.1,29,155.1,1056.34,40,haze
  2007-04-01T00:02:30.000-06:00,30.2,29,155.1,1056.41,36,clear
  2007-04-01T00:02:40.000-06:00,30.2,29,155,1056.48,39,clear
  2007-04-01T00:02:50.000-06:00,30.2,29,1,155,1056.55,60,haze
  2007-04-01T00:03:00.000-06:00,30.2,29,1,155,1056.62,65,haze
  2007-04-01T00:03:10.000-06:00,30.2,29,1,155,1056.69,70,haze
  2007-04-01T00:03:20.000-06:00,29.9,29,1,154.9,1056.76,71,haze
  2007-04-01T00:03:30.000-06:00,29.9,29,1,154.8,1056.83,75,haze
  2007-04-01T00:03:40.000-06:00,29.9,29,1,154.8,1056.89,75,haze
</swe:values>
</om:Observation>
```
As the time of each element in the result array is embedded in the result, the record definition shown in Listing 26 has an explicit “time” element.

Listing 26.  weatherRecord1_t.xml

```xml
<!DOCTYPE swe:DataRecord [ ]>
<swe:DataRecord xmlns:gml="http://www.opengis.net/gml" xmlns:swe="http://www.opengis.net/swe/1.0.1"
xsi:schemaLocation="http://www.opengis.net/sweCommon/1.0.1/swe.xsd">
    <swe:field name="time">
        <swe:Time definition="urn:x-ogc:def:phenomenon:time:iso8601"/>
    </swe:field>
    <swe:field name="AirTemperature">
        <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:AirTemperature">
        </swe:Quantity>
    </swe:field>
    <swe:field name="WindSpeed">
            <swe:uom xlink:href="urn:x-ogc:def:uom:OGC:m_s"/>
        </swe:Quantity>
    </swe:field>
    <swe:field name="WindDirection">
        <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:WindDirectionToNorth">
        </swe:Quantity>
    </swe:field>
    <swe:field name="AtmosphericPressure">
        <swe:Quantity definition="http://sweet.jpl.nasa.gov/ontology/property.owl#AtmosphericPressure">
        </swe:Quantity>
    </swe:field>
    <swe:field name="RelativeHumidity">
        <swe:Quantity definition="http://sweet.jpl.nasa.gov/ontology/property.owl#RelativeHumidity">
        </swe:Quantity>
    </swe:field>
    <swe:field name="Visibility">
        <swe:Category definition="http://sweet.jpl.nasa.gov/ontology/property.owl#Visibility">
            <swe:Category/>
        </swe:Category>
    </swe:field>
</swe:DataRecord>
```

5.5 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 27 describe an observation of a (raw) radiance spectrum corresponding to the LandsatTM bands, made on four stations at three time instants. 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 27.  spectrumSeries3.xml

```xml
<!DOCTYPE om:Observation [ ]>
<om:Observation gml:id="specSeries3" xmlns:cv="http://www.opengis.net/cv/0.2.1"
xmlns:swe="http://www.opengis.net/swe/1.0.1" xmlns:om="http://www.opengis.net/om/0.0"
xmlns:gmil="http://www.opengis.net/gml" xsi:schemaLocation="http://www.opengis.net/cv/0.2.1 cv.xsd http://www.opengis.net/swe/1.0.1 swe.xsd">
    <gml:description>Observation test instance - Multiple compounding axes
    A Landsat TM spectrum is observed on 4 stations at 5 time instants</gml:description>
</om:Observation>
```
<gml:name>Spectrum Series</gml:name>
<om:samplingTime>
  <gml:TimePeriod xlink:href="#tm7c.xml"/>
  <om:result xlink:href="#tpss1"/>
  <om:procedure xlink:href="#foi.xml#stc1"/>
  <om:featureOfInterest xlink:href="#foi.xml#st1"/>
  <om:resultDefinition xlink:href="#tm7c.xml"/>
</om:samplingTime>
<om:TimePeriod>
  <gml:id="tps1"/>
  <gml:beginPosition>2005-06-17</gml:beginPosition>
  <gml:endPosition>2005-06-21</gml:endPosition>
</om:TimePeriod>
</cv:CV_GeometryValuePair>
</cv:element>
</cv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</v:CV_DomainObject>
</cv:CV_DomainObject>
</cv:geometry>
</cv:value>
</cv:CV_GeometryValuePairPair>
</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
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</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
</sv:Record>
</cv:CV_GeometryValuePairPair>
</cv:element>
</cv:CV_GeometryValuePairPair>
</cv:element>
<cv:element>
  <cv:CV_GeometryValuePair>
    <cv:CV_DomainObject>
      <cv:spatialElement xlink:href="./toi.xml#si1"/>
      <cv:temporalElement xlink:href="./toi.xml#ti1"/>
    </cv:CV_DomainObject>
  </cv:CV_GeometryValuePair>
</cv:element>

<cv:element>
  <cv:CV_GeometryValuePair>
    <cv:CV_DomainObject>
      <cv:spatialElement xlink:href="./toi.xml#si2"/>
      <cv:temporalElement xlink:href="./toi.xml#ti2"/>
    </cv:CV_DomainObject>
  </cv:CV_GeometryValuePair>
</cv:element>

<cv:element>
  <cv:CV_GeometryValuePair>
    <cv:CV_DomainObject>
      <cv:spatialElement xlink:href="./toi.xml#si3"/>
      <cv:temporalElement xlink:href="./toi.xml#ti3"/>
    </cv:CV_DomainObject>
  </cv:CV_GeometryValuePair>
</cv:element>

<cv:element>
  <cv:CV_GeometryValuePair>
    <cv:CV_DomainObject>
      <cv:spatialElement xlink:href="./toi.xml#si4"/>
      <cv:temporalElement xlink:href="./toi.xml#ti4"/>
    </cv:CV_DomainObject>
  </cv:CV_GeometryValuePair>
</cv:element>
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The document shown in Listing 28 describes the details of the representation of the value of the observed property, as a swe:DataRecord.

**Listing 28.** tm7c.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<swe:DataRecord gml:Id="TM7c"
xmlns:swe="http://www.opengis.net/swe/1.0.1"
xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsi="http://www.w3.org/1999/XMLSchema"
xs:import "http://www.opengis.net/swe/1.0.1 http://schemas.opengis.net/sweCommon/1.0.1/swe.xsd ">
  <swe:field name="TMBand1">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand1">
    </swe:Quantity>
    <swe:constraint>
      <swe:AllowedValues id="SINGLE_BYTE">
        <swe:interval>0 255</swe:interval>
      </swe:AllowedValues>
    </swe:constraint>
  </swe:field>
  <swe:field name="TMBand2">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand2">
    </swe:Quantity>
    <swe:constraint xlink:href="#SINGLE_BYTE"/>
  </swe:field>
  <swe:field name="TMBand3">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand3">
    </swe:Quantity>
  </swe:field>
</swe:DataRecord>
```

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<swe:DataRecord>
  
  <swe:field name="TMBand4">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand4">
    </swe:Quantity>
  </swe:field>

  <swe:field name="TMBand5">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand5">
    </swe:Quantity>
  </swe:field>

  <swe:field name="TMBand6">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand6">
    </swe:Quantity>
  </swe:field>

  <swe:field name="TMBand7">
    <swe:Quantity definition="urn:x-ogc:def:phenomenon:OGC:TMBand7">
    </swe:Quantity>
  </swe:field>

</swe:DataRecord>