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## **OGC<sup>®</sup> Best Practice for Sensor Web Enablement**

### **Lightweight SOS Profile for Stationary In-Situ Sensors**

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## **i. Preface**

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

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. Document terms and definitions**

This document uses the standard terms defined in Subclause 5.3 of [OGC 06-121r3], which is based on the ISO/IEC Directives, Part 2. Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

## **iii. Submitting organizations**

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

- a. 52° North Initiative for Geospatial Open Source Software GmbH
- b. Institute for Geoinformatics (IfGI), University of Münster (WWU)

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## v. Revision history

Date	Release	Editor	Primary clauses modified	Description
2011-11-09	0.1.0	Simon Jirka	All	First version of the Discussion Paper
2013-02-27	0.2.0	Simon Jirka	Section 6	Addition of SWE Common observation types

## vi. Changes to the OGC Abstract Specification

The OGC<sup>®</sup> Abstract Specification does not require changes to accommodate the technical contents of this document.

## vii. Future work

This profile is intended to provide a starting point for a discussion on a minimum set of elements that are necessary when applying the SOS in practice. Thus, it will be necessary to incorporate the results of the discussion paper into later versions of this document.

This version of the Discussion Paper includes also complex observations containing swe:DataArrays. In order to ensure a harmonised and consistent use, it will be necessary to include more restrictions and guidance on this observation type in the next version of this Discussion Paper.

In addition, this Discussion Paper may serve as the basis for defining domain specific SOS profiles.

## viii. Acknowledgements

This work was supported by the European Environment Agency (EEA; <http://www.eea.europa.eu/>), as well as the projects “Earth Observation and Environmental Modelling for the Mitigation of Health Risks - EO2Heaven” (<http://www.eo2heaven.org>; contract number 244100) and “Uncertainty Enabled Model Web - UncertWeb” (<http://www.uncertweb.org>; contract number 248488) which are co-funded by the European Commission.



## Foreword

This document presents a lightweight profile for the SOS 2.0 standard. This profile is specifically designed for the provision of observations gathered by stationary in-situ sensors.

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

*Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.*

## Introduction

The OGC Sensor Web Enablement architecture (SWE) addresses the integration of sensors and sensor data into Spatial Data Infrastructures (SDI). Within the SWE architecture the Sensor Observation Service (SOS) plays a central role as it defines an interface for accessing sensor data and metadata. This document describes a lightweight profile of the SOS and the data formats used by the SOS: Observations & Measurements (O&M) for encoding measurement data and the Sensor Model Language (SensorML) for encoding metadata. Other SWE standards which provide more specialized functionality are not part of this minimum lightweight SWE profile.

This profile has been designed in a way that is on the one hand efficient and easy to implement and on the other hand standard compliant. Especially the following aspects were considered during the creation of the profile:

- Reducing the number of operations: certain operations of the SOS standard were designed for very specific needs; these operations were left out of this profile
- Reducing the complexity of the SOS operations (e.g. less complex filters for requesting sensor data)
- Focus on fixed in-situ sensors as these sensors are the type of sensors that are used in the broad majority of SWE use cases in practice (for widening this focus in future, extensions may be developed)

In summary the main objective that guided the development of this profile was to support those use cases which are regularly occurring in practice and to leave out those with very specific requirements that go beyond the broad mass of SWE use cases.

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# Lightweight SOS Profile for Stationary In-Situ Sensors Best Practice

## 1 Scope

This Best Practice document describes a lightweight SOS 2.0 profile for stationary in-situ sensors. Besides the SOS itself this document also addresses the data formats used by the SOS: Observations & Measurements 2.0 (O&M) for encoding measurement data and the Sensor Model Language 2.0 (SensorML) for encoding metadata. Other SWE standards which provide more specialized functionality are not part of this minimum lightweight SWE profile.

The aim of this document is to present a common minimum profile of the SOS. The profile is intended to reduce the complexity of the standard by omitting highly specific elements that are not necessary for the majority of use cases that occur in practice. At the same time, the profile is designed in such a way that all SOS implementations that conform to this profile are also compliant to the according OGC specifications.

## 2 Normative references

The following normative documents contain provisions that, 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.

OGC 06-121r3, *OpenGIS<sup>®</sup> Web Services Common Specification*

OGC 07-036, *OpenGIS<sup>®</sup> Geography Markup Language (GML) Encoding Standard*

OGC 08-094r1, *OGC<sup>®</sup> SWE Common Data Model Encoding Standard 2.0.0*

OGC 09-001, *OpenGIS<sup>®</sup> SWE Service Model Implementation Standard 2.0*

OGC 10-025r1, *Observations and Measurements - XML Implementation 2.0*

OGC 12-000, *OGC<sup>®</sup> SensorML: Model and XML Encoding Candidate Standard 2.0*

OGC 12-006, *OGC<sup>®</sup> Sensor Observation Service 2.0 Interface Standard*

NOTE The OWS Common Specification contains a list of normative references that are also applicable to this Implementation Specification.

### 3 Terms and definitions

For the purposes of this specification, the definitions specified in Clause 4 of the OWS Common Implementation Specification [OGC 06-121r3] shall apply. In addition, the terms and definitions as described in the following documents apply:

- OGC 07-036, OpenGIS® Geography Markup Language (GML) Encoding Standard
- OGC 08-094r1, OGC® SWE Common Data Model Encoding Standard 2.0.0
- OGC 09-001, OpenGIS® SWE Service Model Implementation Standard 2.0
- OGC 10-025r1, Observations and Measurements - XML Implementation 2.0
- OGC 12-000, OGC® SensorML: Model and XML Encoding Candidate Standard 2.0
- OGC 12-006, OGC® Sensor Observation Service 2.0 Interface Standard

## **4 Conventions**

### **4.1 Abbreviated terms**

Most of the abbreviated terms listed in Subclause 5.1 of the OWS Common Implementation Specification [OGC 06-121r3] apply to this document, plus the following abbreviated terms.

Some more frequently used abbreviated terms:

O&M	Observations and Measurements
SensorML	Sensor Model Language
SOS	Sensor Observation Service
SWE	Sensor Web Enablement

## 5 Overview

The next sections describe a lightweight profile for the SOS and its accompanying data encodings SensorML and O&M. At the end of this document an annex is provided that contains examples of the operations and encodings that are part of this profile.

This profile is optimized for scenarios where an SOS is utilized to provide interoperable access to data measured within a network of stationary in-situ sensor stations, each of which may have a number of sensors attached. Examples for such sensors are weather stations or air quality stations. Central in such scenarios are the concepts of *sensor*, sensor station (= *sensor system*). The sensor (e.g. a thermometer or anemometer) is attached to the stationary sensor system (e.g. a weather station).

To give an overview, the figure below (Figure 1) displays in an informal way the key elements of the three utilized standards that are used to represent the measured data as well as relevant metadata (SOS, O&M, and SensorML). The figure points out how those elements are interrelated. The elements from the SOS specification are coloured in blue, the O&M elements are displayed in violet and SensorML elements are shown in grey.

As shown in the figure, the SOS and O&M specifications abstract from the term sensor and instead consider the *procedure* concept. In case of this profile, the procedure is always a stationary sensor system, which is modelled in SensorML using the *PhysicalSystem* type. Sensors attached to the sensor system may be modelled as *PhysicalComponents* and associated with the *PhysicalSystem*, however, this profile does not demand the linkage to those subcomponents.

Please note: The operations and their parameters described in this profile constitute a minimum set that shall be supported by every server implementing this profile. Thus, clients shall be able to rely on the implementation of these operations and parameters.

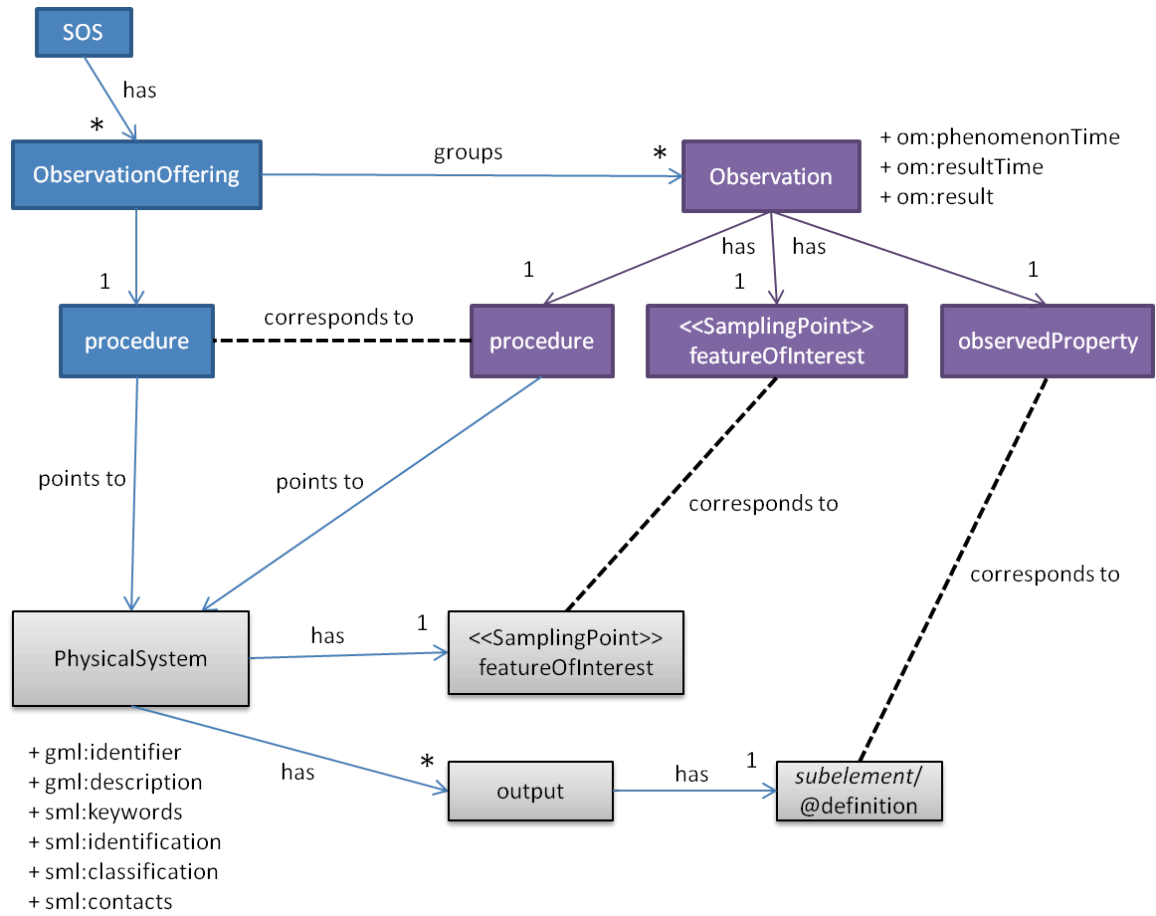


Figure 1: Overview of the key information elements and their relationships (informal representation)



## 6 Observations and Measurements

### 6.1 Introduction

The Observations & Measurements standard offers an encoding for data observed by sensors. It is the standard format the SOS is providing its data. However, as O&M has been designed to be extremely versatile and comprehensive it has also a certain complexity. Thus, this lightweight profile has been defined containing only those elements of O&M which are essential for most common use cases. Within this document we include the following observation types which differ by the result models used:

- om:Measurement*
- om:CountObservation*
- om:TruthObservation*
- om:CategoryObservation*
- om:TextObservation*
- om:ComplexObservation with swe:DataArray*

### 6.2 Common Observation Properties

In order to reduce the complexity of O&M Observations, only a limited set of O&M elements shall be used. These are<sup>1</sup>:

- gml:identifier* (mandatory): this element can be used for uniquely identifying or referring to a specific observation.
- om:phenomenonTime* (mandatory): this element describes the time instant or time period for which the observation contains sensor data; within the lightweight profile this is restricted to the data types *TimeInstant* and *TimePeriod* (other kinds of time (result and valid time) are currently not considered for this profile).
- om:resultTime* (mandatory): this element provides the time when the result became available; often this is identical to the *phenomenonTime*.
- om:procedure* (mandatory): the identifier of the sensor instance that has generated the observation.

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<sup>1</sup> The prefix *gml* indicates that this element is defined in OGC 07-033; the prefix *om* indicates that the element is defined in OGC 10-025r1.

- *om:observedProperty* (mandatory): the identifier of the phenomenon that was observed.
- *om:featureOfInterest* (mandatory): an identifier of the geometric feature (e.g. sensor station) to which the observation is associated; within the lightweight profile this is limited to sampling points.
- *om:result* (mandatory): the observed value; the type of the result is restricted to the types shown in Table 1.

### 6.3 Observation Types

The different subtypes and its result types are shown in Table 1.

**Table 1 — Overview of Observation Types**

Observation Type	Result Type	Description	Example
Measurement	<code>gml:MeasureType</code>	scalar numerical value with unit of measurement	<code>&lt;om:result uom="Cel"&gt;36&lt;/om:result&gt;</code>
CountObservation	<code>xs:integer</code>	count of an observed property	<code>&lt;om:result&gt;12&lt;/om:result&gt;</code>
TruthObservation	<code>xs:boolean</code>	truth value (often existence) of an observed property	<code>&lt;om:result&gt;&gt;true&lt;/om:result&gt;</code>
CategoryObservation	<code>gml:ReferenceType</code>	value from a controlled vocabulary	<code>&lt;om:result xlink:title="storm" xlink:href=" http://en.wikipedia.org/wiki/ /Storm" xsi:type="gml:ReferenceTy pe"/&gt;</code>
TextObservation	<code>xs:string</code>	any kind of textual description of an observed property	<code>&lt;om:result&gt;some text&lt;/om:result&gt;</code>
<code>om:ComplexObservation with swe:DataArray</code>	<code>swe:DataArray</code>	compact representation of multiple observation values (e.g. time series); this observation types needs to be further restricted	-

		and enhanced by guidance in future revisions of the profile.	
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## 7 Sensor Model Language

### 7.1 Introduction

The Sensor Model Language (SensorML) is used within the SOS for encoding sensor metadata documents that are returned in case of *DescribeSensor* requests. This lightweight profile defines a minimum set of mandatory metadata that need to be provided in a SensorML document. Complex elements of SensorML that are intended for very specific applications are not considered within this lightweight profile but may be added if necessary.

### 7.2 Profile-specific Schema of a Sensor System

Every sensor system shall be modeled as a *PhysicalSystem*. The following metadata items are mandatory for a *PhysicalSystem* which conforms to this profile:

*gml:description* (mandatory):

- Short textual description of the sensor or sensor system.

*gml:identifier* (mandatory):

- Unique identifier of the sensor system.

*sml:keywords* (mandatory):

- Terms which help to describe the sensor system and serve for discovery purposes. For example, the phenomena observed by the system or the types of contained sensors can be mentioned.

*sml:identification* (mandatory):

- This element contains identifiers of the sensor system.
- Each "*identifier/Term*" element contained in the "*IdentifierList*" must have a "*definition*" attribute which links to the semantics of the sensor system.
- One identifier has to be present which contains the definition "*urn:ogc:def:identifier:OGC:shortname*". The value of its contained "*Term*" element represents a human understandable name for the instance.
- One identifier has to be present which contains the definition "*urn:ogc:def:identifier:OGC:longname*". The value of its contained "*Term*" element represents a human understandable name for the sensor system.

*sml:classification* (mandatory):

- This element contains classifiers for the sensor system.

- Each "*classifier/Term*" element contained in the "*ClassifierList*" must have a "definition" attribute. This attribute links to the semantics of the identifier.
- One classifier has to be present which contains the definition "<http://www.opengis.net/def/property/OGC/0/SensorType>". The value of its contained "Term" element states the type of the sensor system (e.g., "weather station").

*sml:contacts* (mandatory):

- This element contains contact information about the operator of the sensor.
- The element "*contacts/ContactList/member/gmd:CI\_ResponsibleParty*" has to be present to define the responsible party of the sensor system.

*sml:featuresOfInterest* (mandatory):

- This element contains the real world entity, the feature of interest, which is observed by the sensor system. In case of this profile, the feature of interest is a station and modelled as a *SamplingPoint*.

*sml:outputs* (mandatory):

- The outputs of the sensors attached to the sensor system.
- Each child-element of an "*output*" has to use the "*definition*"-attribute to specify the URI of the observed property. If the child-element of the output is a "*swe:Quantity*" it has to contain the "*swe:uom*" element which specifies the "*code*" attribute stating the UCUM code.
- Depending on the observation types the outputs have to be described as one of the following elements
  - *swe:Quantity* (in case of Measurement)
  - *swe:Count* (in case of CountObservation)
  - *swe:Boolean* (in case of TruthObservation)
  - *swe:Category* (in case of CategoryObservation)
  - *swe:Text* (in case of TextObservation)

## 8 Sensor Observation Service

### 8.1 Introduction

This lightweight SOS profile comprises those operations which are mandatory within the SOS standard (*GetCapabilities*, *DescribeSensor* and *GetObservation*) so that they must be implemented by every standard compliant SOS server. Furthermore the *GetFeatureOfInterest* operation has been included as a mandatory operation within this profile since it allows accessing the geometries of sensor stations.

### 8.2 SOS Operations

#### 8.2.1 GetCapabilities

The *GetCapabilities* operation is common for every OGC web service specification. It is important to support this operation as it provides the metadata necessary for clients to generate valid SOS requests.

The response shall contain the following information:

- the *supported operations* of the SOS instance shall be listed in the `ows:OperationsMetadata` section, if this section has been requested in the request.
- the *identifiers of all sensor instances* encapsulated by the SOS instance shall be provided in the procedure element of each `ObservationOffering` for this sensor.
- the *identifiers of all observed phenomena* shall be provided in the `observedProperty` elements of the `Contents` or `ObservationOfferings`

#### 8.2.2 DescribeSensor

The *DescribeSensor* operation allows retrieving metadata about the sensors encapsulated by a SOS instance. The operation is defined as mandatory in the SOS specification. Thus, it is included in the minimum profile so that servers must offer this operation.

The request of the *DescribeSensor* operation is very simple as the only parameter required by this profile consists of the identifier of the sensor for which a metadata document is requested. The response is a SensorML document (the lightweight structure for the SensorML response is defined section 7).

#### 8.2.3 GetObservation

The *GetObservation* operation is an essential part of the SOS specification as it is the operation for requesting sensor data. Thus, it is obvious that this operation is needed for both servers and clients. However, in order to reduce the complexity of the *GetObservation* operation several restrictions have been defined that limit the query

parameters. In detail, the following parameters are included in this lightweight SOS profile and can be used in a *GetObservation* service request and therefore shall be supported by every SOS server implementation compliant to this profile (please note: the use of these parameters by clients is optional):

- *offering*: the identifier of the offering that contains the requested sensor data
- *temporalFilter*: for specifying the time for which sensor data is requested; the temporal filter is limited within the lightweight SOS profile to the following types:
  - During a time period
  - Equal to a time instant
- *procedure*: the identifiers of the sensor or sensor network instances from which data is requested
- *observedProperty*: the identifiers of the phenomena for which data is requested
- *featureOfInterest*: Identifier of the geometric objects for which sensor data is requested
- *spatialFilter*: is restricted within the lightweight SOS profile to the Bounding box of an area for which data is requested

#### 8.2.4 GetFeatureOfInterest

The *GetFeatureOfInterest* operation allows retrieving the spatial features that are attached to observations. In case of fixed in-situ stations, these features are usually equal to the location of the stations at which measurements were performed. As the access to the geometries of measurements is a requirement for creating map visualizations of the sensors and their data, the *GetFeatureOfInterest* operation has been included for servers in this lightweight SOS profile. However, not every client might rely on this operation (e.g. clients that only show diagrams of time series data).

In order to reduce the complexity of this operation, its request parameters are restricted within this profile. Clients may request geometries using only one of these three parameters:

- *featureOfInterest*: identifier of a feature of interest which shall be returned
- *spatialFilter*: restricted within the lightweight SOS profile to the Bounding box of an area for which features are requested
- *observedProperty*: identifiers of the properties that shall be observed at the requested features

- *procedure*: identifiers of the procedures that shall observe the requested features

In case of this profile, the response of the GetFeatureOfInterest operation shall always contain one or more *SamplingPoints*



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## 10 Examples: Observations & Measurements

### 10.1 Measurement

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example
-point as sampling location
-time instant as phenomenon time
-result is a measure value (double with units of measure information)
=====-->
<om:OM_Measurement gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0 ../observation.xsd">
<!--=====
global identifier of the observation
=====-->
<gml:identifier codeSpace="http://www.myWebSite.org">obsTest1</gml:identifier>
<!--=====
phenomenon time represents the time when the observation was taken (so when the
sensor has interacted with reality
=====-->
<om:phenomenonTime>
  <gml:TimeInstant gml:id="ot1t">
    <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
  </gml:TimeInstant>
</om:phenomenonTime>
<!--=====
result time represents the time when the result value was produced; might differ for
example in case of a soil sample; sample has been taken during phenomenonTime and
then evaluate later in a laboratory during resultTime
=====-->
<om:resultTime xlink:href="#ot1t"/>
<!--=====
procedure has produced the observation's result (usually a sensor)
=====-->
<om:procedure xlink:href="http://www.example.org/register/process/scales34.xml"/>
<!--=====
observedProperty usually contains a link to a vocabulary containing the definition of
the property which has been observed; in case of environmental modelling this is
usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
=====-->
<om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:temperature"/>
<!--=====
feature of interest carries the sampling geometry of the observation
=====-->
<om:featureOfInterest>
  <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
    <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
      OM/2.0/SF_SamplingPoint"/>
    <sf:sampledFeature xsi:nil="true"/>
    <sams:shape>
      <gml:Point gml:id="UOMlocation">
        <gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          52.87 7.78</gml:pos>
        </gml:Point>
      </sams:shape>
    </sams:SF_SpatialSamplingFeature>
</om:featureOfInterest>
<!--=====
observation result is an numerical value with information about the unit of
measurements
=====-->

```

```

    <om:result uom="Cel">36</om:result>
</om:OM_Measurement>

```

## 10.2 CountObservation

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example with
-point as sampling location
-timeInstant as phenomenon time
-result is a count value
=====-->
<om:OM_CountObservation gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0 ../observation.xsd">
  <!--=====
    global identifier of the observation
  =====-->
  <gml:identifier codeSpace="http://www.uncertweb.org">obsTest1</gml:identifier>
  <!--=====
    phenomenon time represents the time when the observation was taken (so when the
    sensor has interacted with reality
  =====-->
  <om:phenomenonTime>
    <gml:TimeInstant gml:id="ot1t">
      <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
    </gml:TimeInstant>
  </om:phenomenonTime>
  <!--=====
    result time represents the time when the result value was produced; might differ for
    example in case of a soil sample; sample has been taken during phenomenonTime and
    then evaluate later in a laboratory during resultTime
  =====-->
  <om:resultTime xlink:href="#ot1t"/>
  <!--=====
    procedure has produced the observation's result (usually a sensor)
  =====-->
  <om:procedure xlink:href="http://www.example.org/register/process/counter.xml"/>
  <!--=====
    observedProperty usually contains a link to a vocabulary containing the definition of
    the property which has been observed; in case of environmental modelling this is
    usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
  =====-->
  <om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:numberOfPersons"/>
  <!--=====
    feature of interest carries the sampling geometry of the observation
  =====-->
  <om:featureOfInterest>
    <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
      <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
        OM/2.0/SF_SamplingPoint"/>
      <sf:sampledFeature xsi:nil="true"/>
      <sams:shape>
        <gml:Point gml:id="UOMlocation">
          <gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
            52.87 7.78</gml:pos>
          </gml:Point>
        </sams:shape>
      </sams:SF_SpatialSamplingFeature>
    </om:featureOfInterest>
  <!--=====
    observation result is a count value
  =====-->
  <om:result>36000</om:result>
</om:OM_CountObservation>

```

### 10.3 TruthObservation

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example with
-point as sampling location
-timeInstant as phenomenonTime
-result is a reference to a coverage on a server
=====-->
<om:OM_TruthObservation gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0 ../observation.xsd">
<!--=====
      global identifier of the observation
=====-->
<gml:identifier codeSpace="http://www.uncertweb.org">obsTest1</gml:identifier>
<!--=====
      phenomenon time represents the time when the observation was taken (so when the
      sensor has interacted with reality
=====-->
<om:phenomenonTime>
  <gml:TimeInstant gml:id="ot1t">
    <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
  </gml:TimeInstant>
</om:phenomenonTime>
<!--=====
      result time represents the time when the result value was produced; might differ for
      example in case of a soil sample; sample has been taken during phenomenonTime and
      then evaluate later in a laboratory during resultTime
=====-->
<om:resultTime xlink:href="#ot1t"/>
<!--=====
      procedure has produced the observation's result (usually a sensor)
=====-->
<om:procedure xlink:href="http://www.example.org/register/process/scales34.xml"/>
<!--=====
      observedProperty usually contains a link to a vocabulary containing the definition of
      the property which has been observed; in case of environmental modelling this is
      usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
=====-->
<om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:temperature"/>
<!--=====
      feature of interest carries the sampling geometry of the observation
=====-->
<om:featureOfInterest>
  <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
    <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
      OM/2.0/SF_SamplingPoint"/>
    <sf:sampledFeature xsi:nil="true"/>
    <sams:shape>
      <gml:Point gml:id="UOMlocation">
        <gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          52.87 7.78</gml:pos>
        </gml:Point>
      </sams:shape>
    </sams:SF_SpatialSamplingFeature>
  </om:featureOfInterest>
<!--=====
      observation result is a boolean (truth) value
=====-->
  <om:result>true</om:result>
</om:OM_TruthObservation>

```

## 10.4 CategoryObservation

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example with
-point as sampling location
-time period as phenomenon time
-result is a categorical value (category with link to code space)
=====-->
<om:OM_CategoryObservation gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0 ../observation.xsd">
  <!--=====
  global identifier of the observation
  =====-->
  <gml:identifier codeSpace="http://www.myWebSite.org">obsTest1</gml:identifier>
  <!--=====
  phenomenon time represents the time when the observation was taken (so when the
  sensor has interacted with reality
  =====-->
  <om:phenomenonTime>
    <gml:TimeInstant gml:id="ot1t">
      <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
    </gml:TimeInstant>
  </om:phenomenonTime>
  <!--=====
  result time represents the time when the result value was produced; might differ for
  example in case of a soil sample; sample has been taken during phenomenonTime and
  then evaluate later in a laboratory during resultTime
  =====-->
  <om:resultTime xlink:href="#ot1t"/>
  <!--=====
  procedure has produced the observation's result (usually a sensor)
  =====-->
  <om:procedure xlink:href="http://www.example.org/register/process/scales34.xml"/>
  <!--=====
  observedProperty usually contains a link to a vocabulary containing the definition of
  the property which has been observed; in case of environmental modelling this is
  usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
  =====-->
  <om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:temperature"/>
  <!--=====
  feature of interest carries the sampling geometry of the observation
  =====-->
  <om:featureOfInterest>
    <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
      <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
        OM/2.0/SF_SamplingPoint"/>
      <sf:sampledFeature xsi:nil="true"/>
      <sams:shape>
        <gml:Point gml:id="UOMlocation">
          <gml:pos srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
            52.87 7.78</gml:pos>
          </gml:Point>
        </sams:shape>
      </sams:SF_SpatialSamplingFeature>
    </om:featureOfInterest>
    <!--=====
    observation result is an uncertainty value
    =====-->
    <om:result codeSpace="http://www.uncertweb.org/tempCodeSpace/tempCategories.xml">
      warm</om:result>
  </om:OM_CategoryObservation>

```

## 10.5 TextObservation

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example with
-point as sampling location
-time instant as phenomenon time
-result is a free text value
=====-->
<om:OM_TextObservation gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0 ../observation.xsd">
  <!--=====
  global identifier of the observation
  =====-->
  <gml:identifier codeSpace="http://www.myWebSite.org">obsTest1</gml:identifier>
  <!--=====
  phenomenon time represents the time when the observation was taken (so when the
  sensor has interacted with reality
  =====-->
  <om:phenomenonTime>
    <gml:TimeInstant gml:id="otlt">
      <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
    </gml:TimeInstant>
  </om:phenomenonTime>
  <!--=====
  result time represents the time when the result value was produced; might differ for
  example in case of a soil sample; sample has been taken during phenomenonTime and
  then evaluate later in a laboratory during resultTime
  =====-->
  <om:resultTime xlink:href="#ot_tp_1"/>
  <!--=====
  procedure has produced the observation's result (usually a sensor)
  =====-->
  <om:procedure xlink:href="http://www.example.org/register/process/scales34.xml"/>
  <!--=====
  observedProperty usually contains a link to a vocabulary containing the definition of
  the property which has been observed; in case of environmental modelling this is
  usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
  =====-->
  <om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:species:flyingHorse"/>
  <!--=====
  feature of interest carries the sampling geometry of the observation
  =====-->
  <om:featureOfInterest>
    <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
      <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
        OM/2.0/SF_SamplingPoint "/>
      <sf:sampledFeature xsi:nil="true"/>
      <sams:shape>
        <gml:Point gml:id="UOMlocation">
          <gml:pos srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
            52.87 7.78</gml:pos>
          </gml:Point>
        </sams:shape>
      </sams:SF_SpatialSamplingFeature>
    </om:featureOfInterest>
    <!--=====
    observation result is free text
    =====-->
    <om:result>I've observed a flying horse.</om:result>
  </om:OM_TextObservation>

```

## 10.6 om:ComplexObservation with swe:DataArray

```

<?xml version="1.0" encoding="UTF-8"?>
<!--=====
This observation depicts an example with
-point as sampling location
-time period as phenomenon time
-result is a swe:DataArray
=====-->
<om:OM_Observation gml:id="obsTest1" xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation="http://www.opengis.net/om/2.0
    http://schemas.opengis.net/om/2.0/observation.xsd
    http://www.opengis.net/swe/2.0
    http://schemas.opengis.net/sweCommon/2.0/swe.xsd">
  <!--=====
  global identifier of the observation
  =====-->
  <gml:identifier codeSpace="http://www.myWebSite.org">obsTest1</gml:identifier>
  <!--=====
  phenomenon time represents the time when the observation was
  taken (so when the sensor has interacted with reality
  =====-->
  <om:phenomenonTime>
    <gml:TimeInstant gml:id="ot1t">
      <gml:timePosition>2005-01-11T16:22:25.00</gml:timePosition>
    </gml:TimeInstant>
  </om:phenomenonTime>
  <!--=====
  result time represents the time when the result value was produced; might differ for
  example in case of a soil sample; sample has been taken during phenomenonTime and
  then evaluate later in a laboratory during resultTime
  =====-->
  <om:resultTime xlink:href="#ot_tp_1"/>
  <!--=====
  procedure has produced the observation's result (usually a sensor)
  =====-->
  <om:procedure xlink:href="http://www.example.org/register/process/scales34.xml"/>
  <!--=====
  observedProperty usually contains a link to a vocabulary containing the definition of
  the property which has been observed; in case of environmental modelling this is
  usually a physical phenomenon (e.g. temperature, air pollutant concentration, etc.)
  =====-->
  <om:observedProperty xlink:href="urn:ogc:def:phenomenon:OGC:air:temperature"/>
  <!--=====
  feature of interest carries the sampling geometry of the observation
  =====-->
  <om:featureOfInterest>
    <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
      <sf:type xlink:href="
        http://www.opengis.net/def/samplingFeatureType/OGC-OM/2.0/SF_SamplingPoint "/>
      <sf:sampledFeature xsi:nil="true"/>
      <sams:shape>
        <gml:Point gml:id="UOMlocation">
          <gml:pos srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
            52.87 7.78</gml:pos>
          </gml:Point>
        </sams:shape>
      </sams:SF_SpatialSamplingFeature>
    </om:featureOfInterest>
  <!--=====
  observation result is a swe:DataArray containing air temperature measurements for
  different heights
  =====

```

```

=====----->
<om:result xsi:type="swe:DataArrayPropertyType">
  <swe:DataArray>
    <swe:elementCount>
      <swe:Count>
        <swe:value>5</swe:value>
      </swe:Count>
    </swe:elementCount>
    <swe:elementType name="point">
      <swe:DataRecord>
        <swe:field name="height">
          <swe:Quantity definition="http://mmisw.org/ont/cf/parameter/height">
            <swe:label>Sampling Point Vertical Location</swe:label>
            <swe:uom code="m"/>
          </swe:Quantity>
        </swe:field>
        <swe:field name="airtemperature">
          <swe:Quantity definition="urn:ogc:def:phenomenon:OGC:air:temperature">
            <swe:label>Air Temperature</swe:label>
            <swe:uom code="Cel"/>
          </swe:Quantity>
        </swe:field>
      </swe:DataRecord>
    </swe:elementType>
    <swe:encoding>
      <swe:TextEncoding blockSeparator=";" tokenSeparator=","/>
    </swe:encoding>
    <swe:values>
      0,20.9;100,19.7;200,18.2;300,17.5;400,16.5
    </swe:values>
  </swe:DataArray>
</om:result>
</om:OM_Observation>

```



## 11 Examples: Sensor Model Language

```

<?xml version="1.0" encoding="UTF-8"?>
<PhysicalSystem gml:id="sensor_id" xmlns="http://www.opengis.net/sensorML/2.0"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xsi:schemaLocation=" http://www.opengis.net/sensorML/2.0
  http://schemas.opengis.net/sensorML/2.0/sensorML.xsd
  http://www.opengis.net/samplingSpatial/2.0
  http://schemas.opengis.net/samplingSpatial/2.0/spatialSamplingFeature.xsd">
<!--=====
gml:description is used for a short textual description of the sensor or sensor system
and the gml:identifier provides a unique identifier of the sensor or sensor system
=====-->
<gml:description>A weather station on top of the 52North building</gml:description>
<gml:identifier codeSpace="not_used">
  urn:ogc:object:feature:Sensor:52North:weatherStation123
</gml:identifier>
<!--=====
For discovery purposes, human-readable keywords shall be given. For example, the
phenomena observed by the system or the types of contained sensors can be mentioned.
=====-->
<keywords>
  <KeywordList>
    <keyword>weather station</keyword>
    <keyword>precipitation</keyword>
    <keyword>wind speed</keyword>
    <keyword>temperature</keyword>
  </KeywordList>
</keywords>
<!--=====
Each "identifier/Term" element contained in the "IdentifierList" must have a
"definition" attribute. This attribute links to the semantics of the identifier.

One identifier has to contain the definition "urn:ogc:def:identifier:OGC:shortname".
The value of its contained "Term" element represents a human understandable name for
the instance.

One identifier has to contain the definition "urn:ogc:def:identifier:OGC:longname".
The value of its contained "Term" element represents a human understandable name for
the instance.
=====-->
<identification>
  <IdentifierList>
    <identifier>
      <Term definition="urn:ogc:def:identifier:OGC:shortname">
        <label>short name</label>
        <value>Weather station 123</value>
      </Term>
    </identifier>
    <identifier>
      <Term definition="urn:ogc:def:identifier:OGC:longname">
        <label>long name</label>
        <value>Weather station 123 on top of the 52North building</value>
      </Term>
    </identifier>
  </IdentifierList>
</identification>
<!--=====
Each "classifier/Term" element contained in the "ClassifierList" must have a
"definition" attribute. This attribute links to the semantics of the identifier.
=====-->

```

```

<classification>
  <ClassifierList>
    <classifier>
      <Term definition="http://www.opengis.net/def/property/OGC/0/SensorType">
        <label>sensorType</label>
        <value>weather station</value>
      </Term>
    </classifier>
  </ClassifierList>
</classification>
<!--=====
The element "contacts/ContactList/member/gmd:CI_ResponsibleParty" has to be present to
define the responsible party of the sensor system.
=====-->
<contacts>
  <ContactList>
    <member>
      <gmd:CI_ResponsibleParty>
        <gmd:individualName>
          <gco:CharacterString>Arne Bröring</gco:CharacterString>
        </gmd:individualName>
        <gmd:organisationName>
          <gco:CharacterString>52North</gco:CharacterString>
        </gmd:organisationName>
        <gmd:positionName>
          <gco:CharacterString>Software Engineer</gco:CharacterString>
        </gmd:positionName>
        <gmd:contactInfo>
          <gmd:CI_Contact>
            <gmd:address>
              <gmd:CI_Address>
                <gmd:deliveryPoint>
                  <gco:CharacterString>Martin-Luther-King-Weg
                    24</gco:CharacterString>
                </gmd:deliveryPoint>
                <gmd:city>
                  <gco:CharacterString>Muenster</gco:CharacterString>
                </gmd:city>
                <gmd:country>
                  <gco:CharacterString>Germany</gco:CharacterString>
                </gmd:country>
                <gmd:electronicMailAddress>
                  <gco:CharacterString>swe@52north.org</gco:CharacterString>
                </gmd:electronicMailAddress>
              </gmd:CI_Address>
            </gmd:address>
            <gmd:onlineResource>
              <gmd:CI_OnlineResource>
                <gmd:linkage>
                  <gmd:URL>http://52North.org</gmd:URL>
                </gmd:linkage>
              </gmd:CI_OnlineResource>
            </gmd:onlineResource>
          </gmd:CI_Contact>
        </gmd:contactInfo>
        <gmd:role>
          <gmd:CI_RoleCode codeList="someServer/codeList.xml#CI_RoleCode"
            codeListValue="pointOfContact"/>
        </gmd:role>
      </gmd:CI_ResponsibleParty>
    </member>
  </ContactList>
</contacts>
<!--=====
The geometric sensor to which the system is associated
=====-->
<featuresOfInterest>
  <FeatureList>
    <member>
      <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">

```

```

    <gml:identifier codeSpace="">
      http://myServer.org/features/SamplingPointAt52NorthHeadquarters
    </gml:identifier>
    <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
      OM/2.0/SF_SamplingPoint"/>
    <sf:sampledFeature xsi:nil="true"/>
    <sams:shape>
      <gml:Point gml:id="UOMlocation">
        <gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          50.7167 7.76667</gml:pos>
        </gml:Point>
      </sams:shape>
    </sams:SF_SpatialSamplingFeature>
  </member>
</FeatureList>
</featuresOfInterest>
<!--=====
The "OutputList"-element has to list up at least all "output"s of the PhysicalSystem.
Each child-element of an "output" has to use the "definition"-attribute to specify the
URI of the observed property. If the child-element of the output is a "swe:Quantity"
it has to contain the "swe:uom" element which specifies the "code" attribute stating
the UCUM code.
=====-->
<outputs>
  <OutputList>
    <output name="precipitation">
      <swe:Quantity
        definition="http://sweet.jpl.nasa.gov/2.3/phen.owl#Precipitation">
        <swe:uom code="mm"/>
      </swe:Quantity>
    </output>
    <output name="windSpeed">
      <swe:Quantity
        definition="http://sweet.jpl.nasa.gov/2.0/atmoWind.owl#WindSpeed">
        <swe:uom code="m/s"/>
      </swe:Quantity>
    </output>
    <output name="temperature">
      <swe:Quantity
        definition="http://sweet.jpl.nasa.gov/2.3/propTemperature.owl#Temperature">
        <swe:uom code="Cel"/>
      </swe:Quantity>
    </output>
  </OutputList>
</outputs>
</PhysicalSystem>

```

## 12 Examples: Sensor Observation Service

### 12.1 GetCapabilities

#### 12.1.1 Request

```
<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
http://www.opengis.net/sos/2.0
http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:ows="http://www.opengis.net/ows/1.1">
  <soap12:Header>
    <wsa:To>http://www.ogc.org/SPS</wsa:To>
    <wsa:Action>http://www.opengis.net/sps/2.0/GetCapabilities</wsa:Action>
    <wsa:ReplyTo>
      <wsa:Address>http://my.client.com/client/myReceiver</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>http://my.client.com/uid/msg-0010</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <GetCapabilities service="SOS">
      <ows:AcceptVersions>
        <ows:Version>2.0.0</ows:Version>
      </ows:AcceptVersions>
      <ows:Sections>
        <ows:Section>OperationsMetadata</ows:Section>
        <ows:Section>ServiceIdentification</ows:Section>
        <ows:Section>ServiceProvider</ows:Section>
        <ows:Section>Filter_Capabilities</ows:Section>
        <ows:Section>InsertionCapabilities</ows:Section>
        <ows:Section>Contents</ows:Section>
      </ows:Sections>
    </GetCapabilities>
  </soap12:Body>
</soap12:Envelope>
```

## 12.1.2 Response

```

<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
    http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
    http://www.opengis.net/sos/2.0
    http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:ows="http://www.opengis.net/ows/1.1"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns:xlink="http://www.w3.org/1999/xlink">
  <soap12:Header>
    <wsa:To>http://my.client.com/client/myReceiver</wsa:To>
    <wsa:Action>http://www.opengis.net/sos/2.0/GetCapabilitiesResponse</wsa:Action>
    <wsa:RelatesTo>http://my.client.com/uid/msg-0010</wsa:RelatesTo>
  </soap12:Header>
  <soap12:Body>
    <sos:Capabilities version="2.0.0">
      <ows:ServiceIdentification>
        <ows:Title>My SOS</ows:Title>
        <ows:ServiceType codeSpace="http://opengeospatial.net">
          OGC:SOS</ows:ServiceType>
        <ows:ServiceTypeVersion>1.0.0</ows:ServiceTypeVersion>
        <ows:Profile>http://www.opengis.net/spec/SOS/2.0/conf/gfoi</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/obsByIdRetrieval</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/sensorInsertion</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/sensorDeletion</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/obsInsertion</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/resultInsertion</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/resultRetrieval</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SOS/2.0/conf/spatialFilteringProfile
        </ows:Profile>
        <ows:Profile>http://www.opengis.net/spec/SOS/2.0/conf/soap</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SWE/2.0/conf/uml-block-components
        </ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SWE/2.0/conf/uml-record-components
        </ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SWE/2.0/conf/xsd-record-components
        </ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/SWE/2.0/conf/xsd-block-components
        </ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/OMXML/2.0/conf/samplingPoint</ows:Profile>
        <ows:Profile>
          http://www.opengis.net/spec/OMXML/2.0/conf/observation</ows:Profile>
        <ows:Fees>NONE</ows:Fees>
        <ows:AccessConstraints>NONE</ows:AccessConstraints>
      </ows:ServiceIdentification>
      <!--=====
      The filterCapabilities section lists the filters and operands which are
      supported in the observation, result and feature retrieval operations.
    
```

```

----->
<sos:filterCapabilities>
  <fes:Filter_Capabilities>
    <fes:Conformance>
      <fes:Constraint name="ImplementsQuery">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsAdHocQuery">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsFunctions">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsMinStandardFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsStandardFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsMinSpatialFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>true</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsSpatialFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>true</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsMinTemporalFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>true</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsTemporalFilter">
        <ows:NoValues/>
        <ows:DefaultValue>>true</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsVersionNav">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsSorting">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
      <fes:Constraint name="ImplementsExtendedOperators">
        <ows:NoValues/>
        <ows:DefaultValue>>false</ows:DefaultValue>
      </fes:Constraint>
    </fes:Conformance>
    <fes:Spatial_Capabilities>
      <fes:GeometryOperands>
        <fes:GeometryOperand name="gml:Point"/>
        <fes:GeometryOperand name="gml:Polygon"/>
      </fes:GeometryOperands>
      <fes:SpatialOperators>
        <fes:SpatialOperator name="BBOX"/>
      </fes:SpatialOperators>
    </fes:Spatial_Capabilities>
    <fes:Temporal_Capabilities>
      <fes:TemporalOperands>
        <fes:TemporalOperand name="gml:TimePeriod"/>
        <fes:TemporalOperand name="gml:TimeInstant"/>
      </fes:TemporalOperands>
      <fes:TemporalOperators>
        <fes:TemporalOperator name="During"/>
        <fes:TemporalOperator name="TEquals"/>
      </fes:TemporalOperators>
    </fes:Temporal_Capabilities>
  </fes:Filter_Capabilities>
</sos:filterCapabilities>

```

```

        </fes:TemporalOperators>
    </fes:Temporal_Capabilities>
</fes:Filter_Capabilities>
</sos:filterCapabilities>
<!--=====
The contents section describes the data the SOS instance offers.
=====-->
<sos:contents>
  <sos:Contents>
    <!--=====
    The format in which sensor instances are described.
    =====-->
    <swes:procedureDescriptionFormat>http://www.opengis.net/sensorML/2.0
      </swes:procedureDescriptionFormat>
    <!--=====
    The observed properties for which the SOS instance offers data.
    =====-->
    <swes:observableProperty>
      http://sweet.jpl.nasa.gov/2.3/phen.owl#Precipitation
    </swes:observableProperty>
    <swes:observableProperty>
      http://sweet.jpl.nasa.gov/2.0/atmoWind.owl#WindSpeed
    </swes:observableProperty>
    <swes:observableProperty>
      http://sweet.jpl.nasa.gov/2.3/propTemperature.owl#Temperature
    </swes:observableProperty>
    <!--=====
    Listing of the relatedFeature for discovery purposes (e.g. countries in
    which the data was measured. The sampling Features are not listed here!
    Sampling features can be queried via GetFeatureOfInterest.
    =====-->
    <swes:relatedFeature>
      <swes:FeatureRelationship>
        <swes:target xlink:href="http://myServer.org/features/Germany"/>
      </swes:FeatureRelationship>
    </swes:relatedFeature>
    <swes:relatedFeature>
      <swes:FeatureRelationship>
        <swes:target xlink:href="http://myServer.org/features/Netherlands"/>
      </swes:FeatureRelationship>
    </swes:relatedFeature>
    <!--=====
    The offerings of the SOS instance. For each offering description,
    identifier, name, associated procedure, observed area and time period are
    provided.
    =====-->
    <swes:offering>
      <sos:ObservationOffering>
        <swes:description>
          Offering for observations measured at weather station 123
        </swes:description>
        <swes:identifier>
          urn:ogc:object:Offering:52North:weatherStation123
        </swes:identifier>
        <swes:name>Offering of weather station 123</swes:name>
        <swes:procedure>
          urn:ogc:object:feature:Sensor:52North:weatherStation123
        </swes:procedure>
        <sos:observedArea>
          <gml:Envelope srsName=
            "http://www.opengis.net/def/crs/EPSG/0/4326">
            <gml:lowerCorner>50.7167 7.76667</gml:lowerCorner>
            <gml:upperCorner>50.7167 7.76667</gml:upperCorner>
          </gml:Envelope>
        </sos:observedArea>
        <sos:phenomenonTime>
          <gml:TimePeriod gml:id="phenomenonTime">
            <gml:beginPosition>2009-01-11T16:22:25.00Z</gml:beginPosition>
            <gml:endPosition>2011-08-21T08:32:10.00Z</gml:endPosition>
          </gml:TimePeriod>
        </sos:phenomenonTime>
      </sos:ObservationOffering>
    </swes:offering>
  </sos:Contents>
</sos:contents>

```

```

        </sos:phenomenonTime>
    </sos:ObservationOffering>
</swes:offering>
<!--=====
The format in which observations are returned.
=====-->
<sos:responseFormat>http://www.opengis.net/om/2.0</sos:responseFormat>
<!--=====
The supported observation types.
=====-->
<sos:observationType>
    http://www.opengis.net/def/observationType/OGC-OM/2.0/OM_Measurement
</sos:observationType>
<sos:observationType>
    http://www.opengis.net/def/observationType/OGC-OM/2.0/
    OM_CountObservation
</sos:observationType>
<sos:observationType>
    http://www.opengis.net/def/observationType/OGC-OM/2.0/
    OM_TruthObservation
</sos:observationType>
<sos:observationType>
    http://www.opengis.net/def/observationType/OGC-
    OM/2.0/OM_CategoryObservation
</sos:observationType>
<sos:observationType>
    http://www.opengis.net/def/observationType/OGC-OM/2.0/
    om:OM_TextObservation
</sos:observationType>
</sos:Contents>
</sos:contents>
</sos:Capabilities>
</soap12:Body>
</soap12:Envelope>

```



## 12.2 DescribeSensor

### 12.2.1 Request

```
<?xml version="1.0" encoding="UTF-8"?>
<swes:DescribeSensor xmlns="http://www.opengis.net/swes/2.0" service="SOS"
  version="2.0.0"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/swes/2.0
  http://schemas.opengis.net/swes/2.0/swes.xsd">
  <procedure>urn:ogc:object:feature:Sensor:52North:weatherStation123</procedure>
  <procedureDescriptionFormat>
    http://www.opengis.net/sensorml/1.0.1</procedureDescriptionFormat>
</swes:DescribeSensor>
```

### 12.2.2 Response

For the response, please refer to section 11.

## 12.3 GetObservation

### 12.3.1 Request

```

<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
    http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
    http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns:om="http://www.opengis.net/om/1.0">
  <soap12:Header>
    <wsa:To>http://www.ogc.org/SOS</wsa:To>
    <wsa:Action>http://www.opengis.net/sos/2.0/GetObservation</wsa:Action>
    <wsa:ReplyTo>
      <wsa:Address>http://my.client.com/client/myReceiver</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>http://my.client.com/uid/msg-0010</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <GetObservation service="SOS" version="2.0.0">
      <!--=====
      The observed properties for which data is requested
      =====-->
      <observedProperty>
        http://sweet.jpl.nasa.gov/2.3/phen.owl#Precipitation</observedProperty>
      <observedProperty>
        http://sweet.jpl.nasa.gov/2.3/propTemperature.owl#Temperature
      </observedProperty>
      <!--=====
      The time period for which data is requested
      =====-->
      <temporalFilter>
        <fes:During>
          <fes:ValueReference>phenomenonTime</fes:ValueReference>
          <gml:TimePeriod gml:id="tp1">
            <gml:beginPosition>2008-01-01</gml:beginPosition>
            <gml:endPosition>2011-05-01T17:44:15+00:00</gml:endPosition>
          </gml:TimePeriod>
        </fes:During>
      </temporalFilter>
      <!--=====
      The observed feature of interest for which data is requested
      =====-->
      <featureOfInterest>
        http://myServer.org/features/SamplingPointAt52NorthHeadquarters
      </featureOfInterest>
    </GetObservation>
  </soap12:Body>
</soap12:Envelope>

```

## 12.3.2 Response

```

<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
http://www.opengis.net/sos/2.0
http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:ows="http://www.opengis.net/ows/1.1"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink">
  <soap12:Header>
    <wsa:To>http://my.client.com/client/myReceiver</wsa:To>
    <wsa:Action>http://www.opengis.net/sos/2.0/GetObservationResponse</wsa:Action>
    <wsa:RelatesTo>http://my.client.com/uid/msg-0010</wsa:RelatesTo>
  </soap12:Header>
  <soap12:Body>
    <sos:GetObservationResponse xmlns="http://www.opengis.net/sos/2.0">
      <!--=====
      An observationData elements containing an O&M observation
      =====-->
      <observationData>
        <om:OM_Measurement gml:id="o1">
          <gml:identifier codeSpace="not_used">
            obsTestWeatherStation</gml:identifier>
          <om:phenomenonTime>
            <gml:TimeInstant gml:id="p1">
              <gml:timePosition>2009-01-11T16:22:25.00Z</gml:timePosition>
            </gml:TimeInstant>
          </om:phenomenonTime>
          <om:resultTime xlink:href="#p1"/>
          <om:procedure
            xlink:href="urn:ogc:object:feature:Sensor:52North:weatherStation123"/>
          <om:observedProperty
            xlink:href="http://sweet.jpl.nasa.gov/2.3/propTemperature.owl
            #Temperature"/>
          <om:featureOfInterest
            xlink:href="http://myServer.org/features/
            SamplingPointAt52NorthHeadquarters"/>
          <om:result xsi:type="gml:MeasureType" uom="Cel">28</om:result>
        </om:OM_Measurement>
      </observationData>
      <!--=====
      Multiple observationData elements containing O&M observations as described in
      section 10
      =====-->
    </sos:GetObservationResponse>
  </soap12:Body>
</soap12:Envelope>

```

## 12.4 GetFeatureOfInterest

### 12.4.1 Request

```
<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
http://www.opengis.net/sos/2.0
http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soap12:Header>
    <wsa:To>http://mySOSURL</wsa:To>
    <wsa:Action>http://www.opengis.net/sos/2.0/GetFeatureOfInterest</wsa:Action>
    <wsa:ReplyTo>
      <wsa:Address>http://my.client.com/client/myReceiver</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>http://my.client.com/uid/msg-0010</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <GetFeatureOfInterest xmlns="http://www.opengis.net/sos/2.0" service="SOS"
      version="2.0.0">
      <!--=====
      Sptial filter describing the bounding box for which features of interest are
      requested.
      =====>
      <spatialFilter>
        <fes:Contains>
          <fes:ValueReference>sams:shape</fes:ValueReference>
          <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
            <gml:lowerCorner>50 4</gml:lowerCorner>
            <gml:upperCorner>53 8</gml:upperCorner>
          </gml:Envelope>
        </fes:Contains>
      </spatialFilter>
    </GetFeatureOfInterest>
  </soap12:Body>
</soap12:Envelope>
```

## 12.4.2 Response

```

<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
    http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd
    http://www.opengis.net/samplingSpatial/2.0
    http://schemas.opengis.net/samplingSpatial/2.0/spatialSamplingFeature.xsd
    http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
  xmlns:sf="http://www.opengis.net/sampling/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soap12:Header>
    <wsa:To>http://mySOSURL</wsa:To>
    <wsa:Action>
      http://www.opengis.net/sos/2.0/GetFeatureOfInterestResponse</wsa:Action>
    <wsa:ReplyTo>
      <wsa:Address>http://my.client.com/client/myReceiver</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>http://my.client.com/uid/msg-0010</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <sos:GetFeatureOfInterestResponse xmlns="http://www.opengis.net/sos/2.0">
      <featureMember>
        <!--=====
        One feature of interest.
        =====-->
        <sams:SF_SpatialSamplingFeature gml:id="SamplingPoint1">
          <gml:identifier codeSpace="">
            http://myServer.org/features/SamplingPointAt52NorthHeadquarters
          </gml:identifier>
          <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
            OM/2.0/SF_SamplingPoint"/>
          <sf:sampledFeature xsi:nil="true"/>
          <sams:shape>
            <gml:Point gml:id="UOMlocation">
              <gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
                50.7167 7.76667</gml:pos>
            </gml:Point>
          </sams:shape>
        </sams:SF_SpatialSamplingFeature>
      </featureMember>
      <!--=====
      Further featureMember element may follow if multiple features apply to the
      criteria specified in the request.
      =====-->
    </sos:GetFeatureOfInterestResponse>
  </soap12:Body>
</soap12:Envelope>

```