Providing INSPIRE measurement data

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Part 1. Introduction

Context

- 10 years ago
  - Geospatial information was hardly (if at all) exchanged in a streamlined way
- Now
  - Extensive use of WMS/WFS/WCS/etc.

- It is time to do the same for observation datasets
  - Standards & tools are waiting for you
- Fasten your seatbelts & let's go for a tour

Context

- The number of devices connected to the Internet exceeded that of people in 2008
- Connected devices expected to reach 50 billion in 2020 *(Swan, 2012)*
- Environmental wireless sensor networks in the IoT have a new kind of scope which can be applied to a wide range of uses *(Martinez, 2004)*
- This is creating a **revolution in all environmental sciences** similar to the one generated by the use of satellite remote sensing in the 1970s *(Hart et. al. 2006)*
- Going beyond the Geospatial
  - limited number of features of interest
  - terabytes of temporal data

Context

- INSPIRE as Framework Directive is not only focused on the *'spatial'*
  - ex : Environmental Monitoring Facilities definition : "... includes observation and measurement of ... by or on behalf of public authorities.
- Thus:
  - Necessity to provide observation data in Annex II and Annex III
  => Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development
- SOS is seen as one of the possible candidates for the extension of TG for INSPIRE Download services (v. 3.0)

O&M Data Models in INSPIRE

7 Themes integrating Observations

    A. Geology

    B. Oceanographic Geographical Features

    C. Atmospheric Conditions

    D. Environmental Monitoring Facilities

    E. Soil

    F. Species Distribution

    G. Natural Risk Zones

O&M Data Models in INSPIRE

Possible future extensions

  a. Area management/restriction/regulation zones ...
  b. Human Health and Safety
  c. Land cover
  d. Production and industrial facilities
  e. Statistical units & Population distribution,demography
  f. Utility and governmental services
  g. Habitats & biotopes

SWE Overview

OGC Sensor Web Enablement Suite (SWE) provides base data and service standards

- Observations & Measurements (O&M):
  - Base data model for provision of observational or measurement data
  - Integrated into several INSPIRE data models
- Sensor Observation Service (SOS):
  - OGC Webservice for provision of O&M data
  - Same structure as other OGC services
  - Tailored for access to O&M data with focus on time series
- Sensor Model Language (SensorML)
  - Description of measurement process
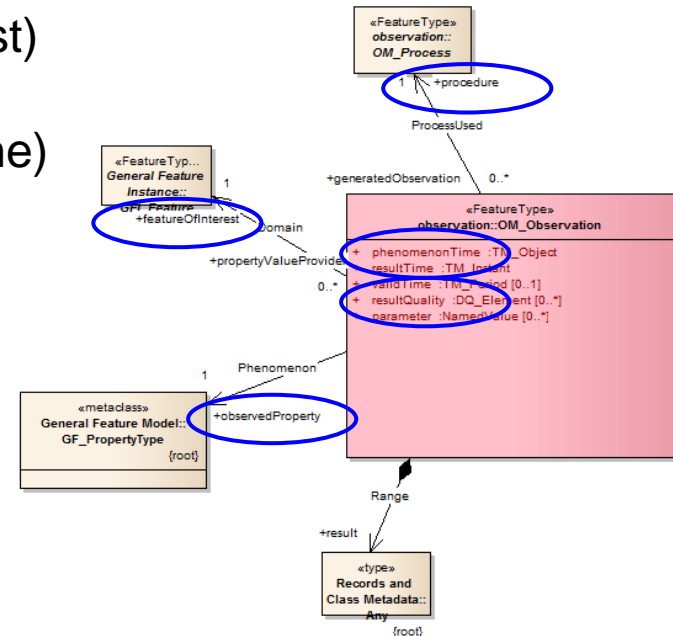 - In INSPIRE use INSPIRE Process

What is an observation?

To understand the data from an observation or measurement, we must know:
- What was measured (observedProperty)
- Where was it measured (featureOfInterest)
- How was it measured (procedure)
- When was it measured (phenomenonTime)
- Data quality information (resultQuality)

And of course, we need
the result of the observation.

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Note: parts already provided with EF Facility
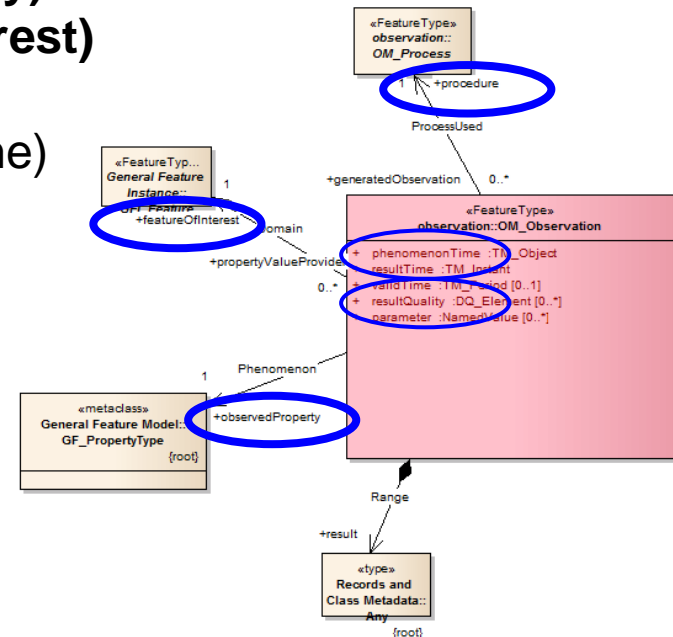
Feature Referencing Observations
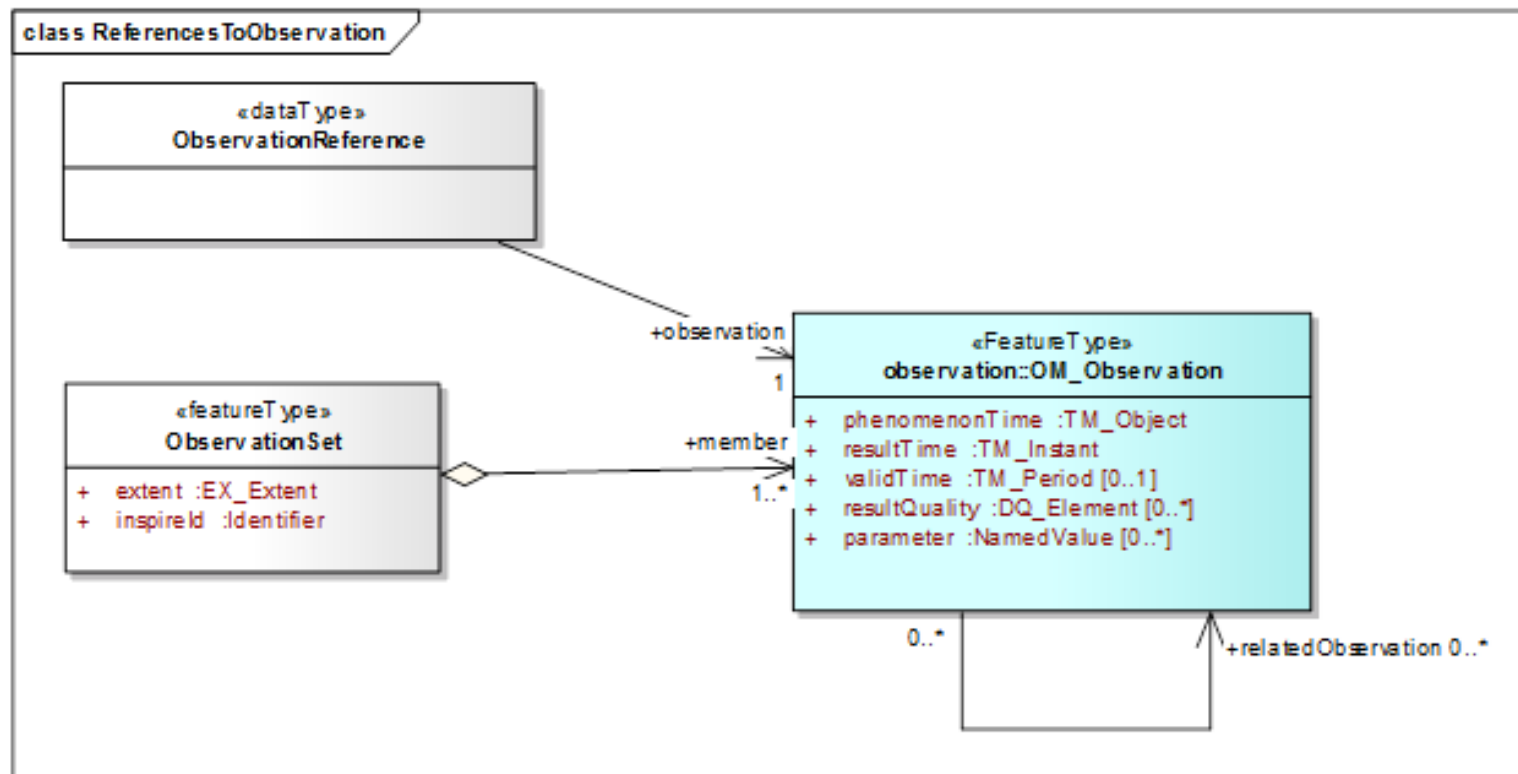
Observation Referencing Feature

```
<om:parameter>
   <om:NamedValue>
         <om:name xlink:href="http://.../SP/"/>
         <om:value xlink:href="http://.../SamplingPoint_1"/>
   </om:NamedValue>
</om:parameter>
```
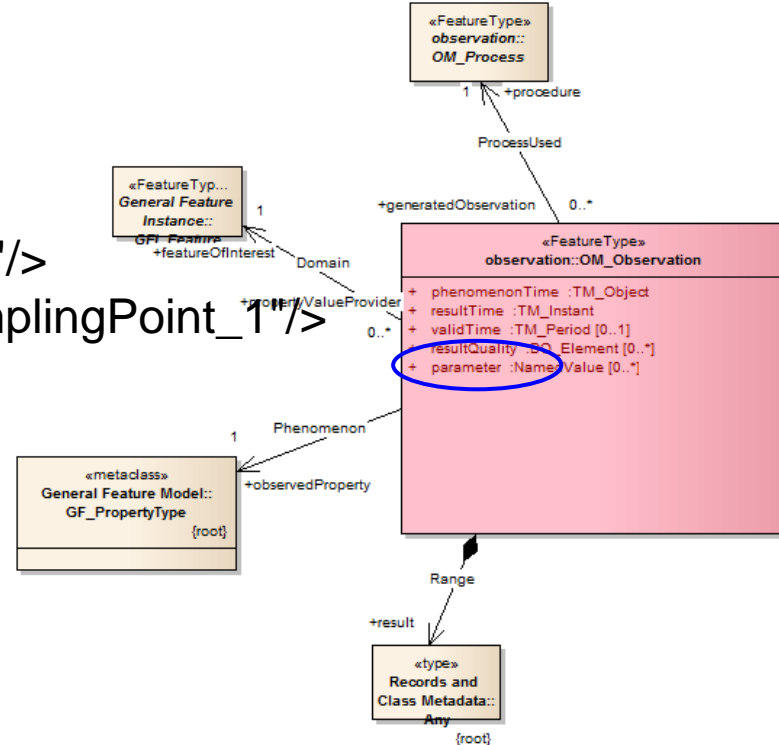
SOS in a nutshell

- OGC Standard
- Current version: 2.0
- Applicable when sensor data needs to be managed in an interoperable way
- Part of SWE suite
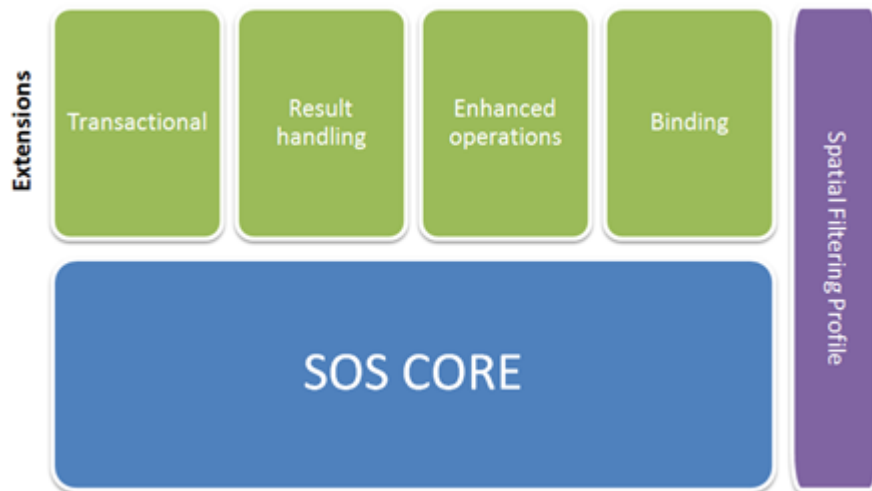
Sensor Web Enablement suite

SOS Core – Operations:
1. *GetCapabilities*
2. *DescribeSensor*
3. *GetObservation*

Sensor Observation Service

request data   subscribe & specify filter   notify (e.g. SMS)   submit task

SOS   SES   WNS   SPS

trigger alarm

observations   commands

data stream

1.: Water_level > 500 cm: SMS
2.: Wind_speed > 20 m/s
   & Wind_direction = NW: E-Mail

Extensions

Transactional	Result handling	Enhanced operations	Binding

Spatial Filtering Profile

SOS CORE

SOS Core – Operations:
1. *GetCapabilities*
2. *DescribeSensor*
3. *GetObservation*
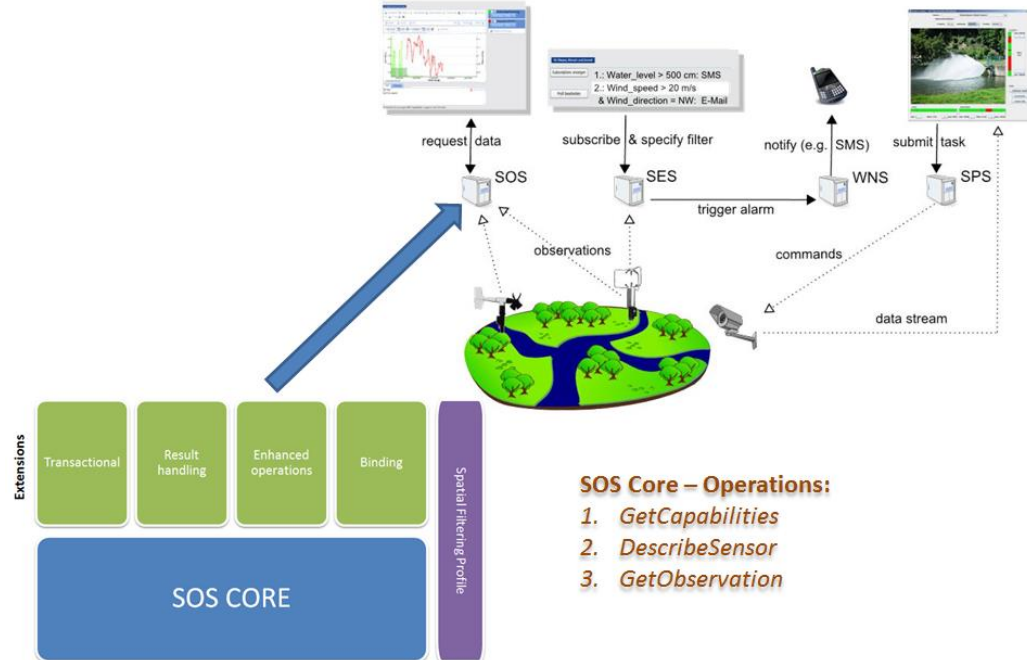
SOS as an INSPIRE Download Service

- SOS is seen as one of the possible candidates for the extension of TG for INSPIRE Download services (v. 3.0)
- JRC study on SOS (2014)
  - Maturity of clients/servers
  - Mapping between SOS 2.0 specs and INSPIRE NS Regulation
  - Open Source Implementation (52North SOS)

- MIG Sub-group (MIWP-7a)
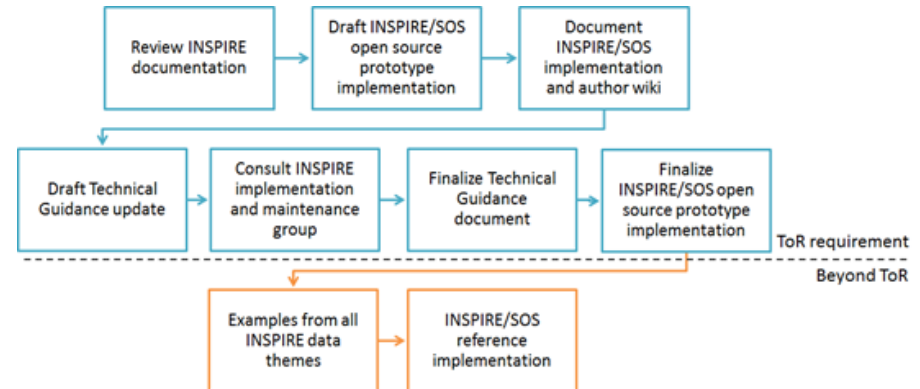
MIWP7-a "SOS sub-group"

- Members of the sub-group:

  - Member State representatives: 13

    - Environmental agencies

    - Research

    - Private sector

  - JRC: 2

  - Represented domains:

    - Air quality (AT, IT)
    - Geology and Soil (FR, SE)
    - Marine& Meto (IT, AT, FR)
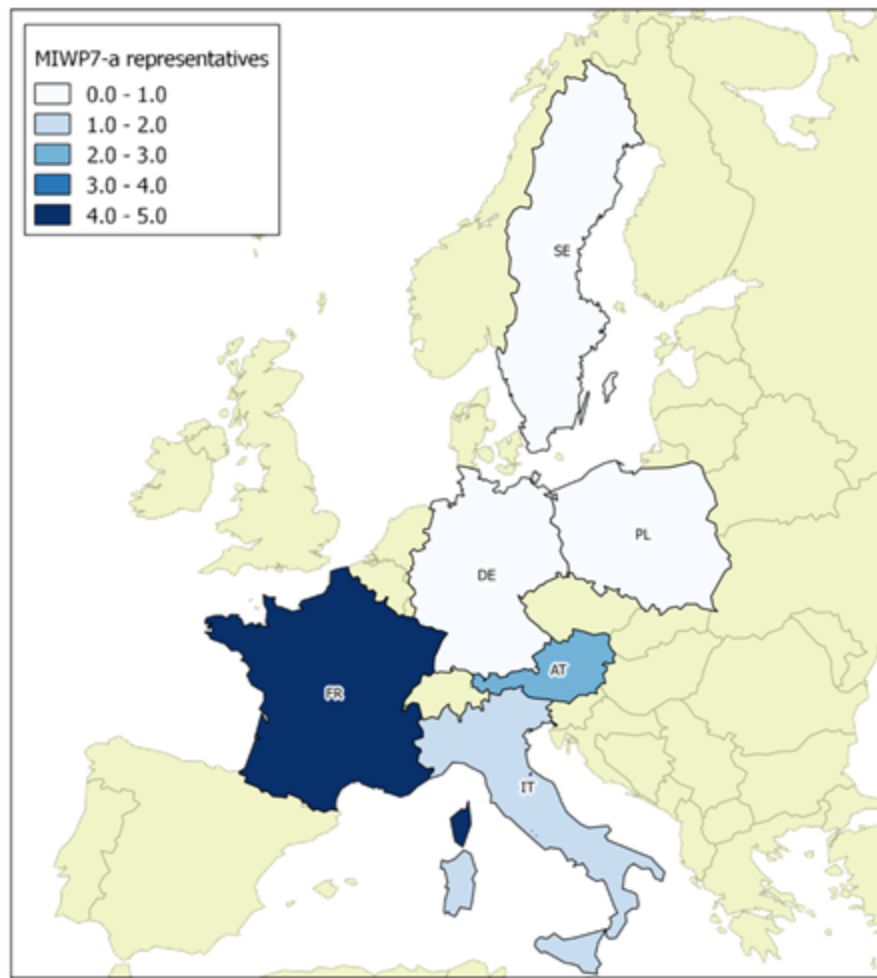
O&M Guidelines

- Provide recommendations and guidance for use of O&M in INSPIRE
- Design Patterns provide support in structuring different types of observations
- INSPIRE Extensions are described:
  - INSPIRE Process
  - Specialized Observations
  - Observable Properties
  - Options for result encoding
  - Referencing Observations

O&M Guidelines: Point - Single Result
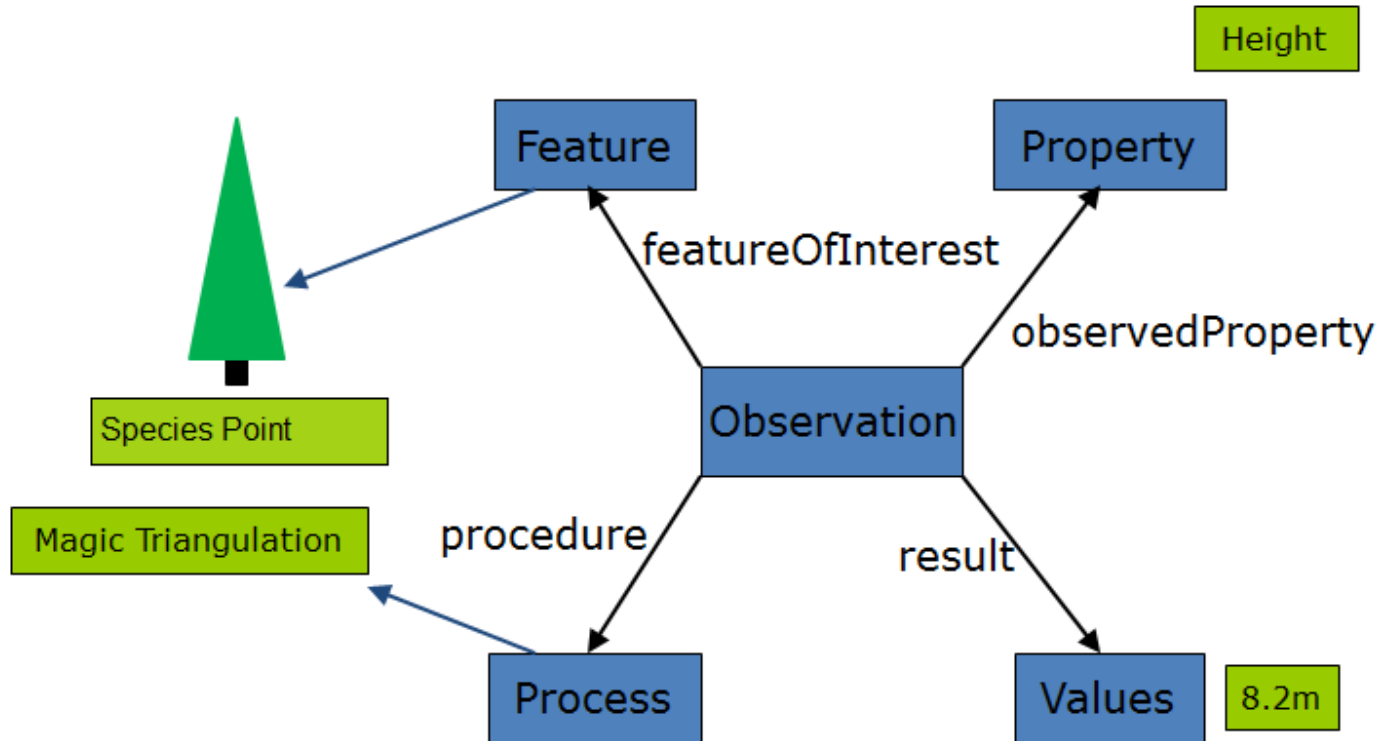
O&M Guidelines: Point - Single Result
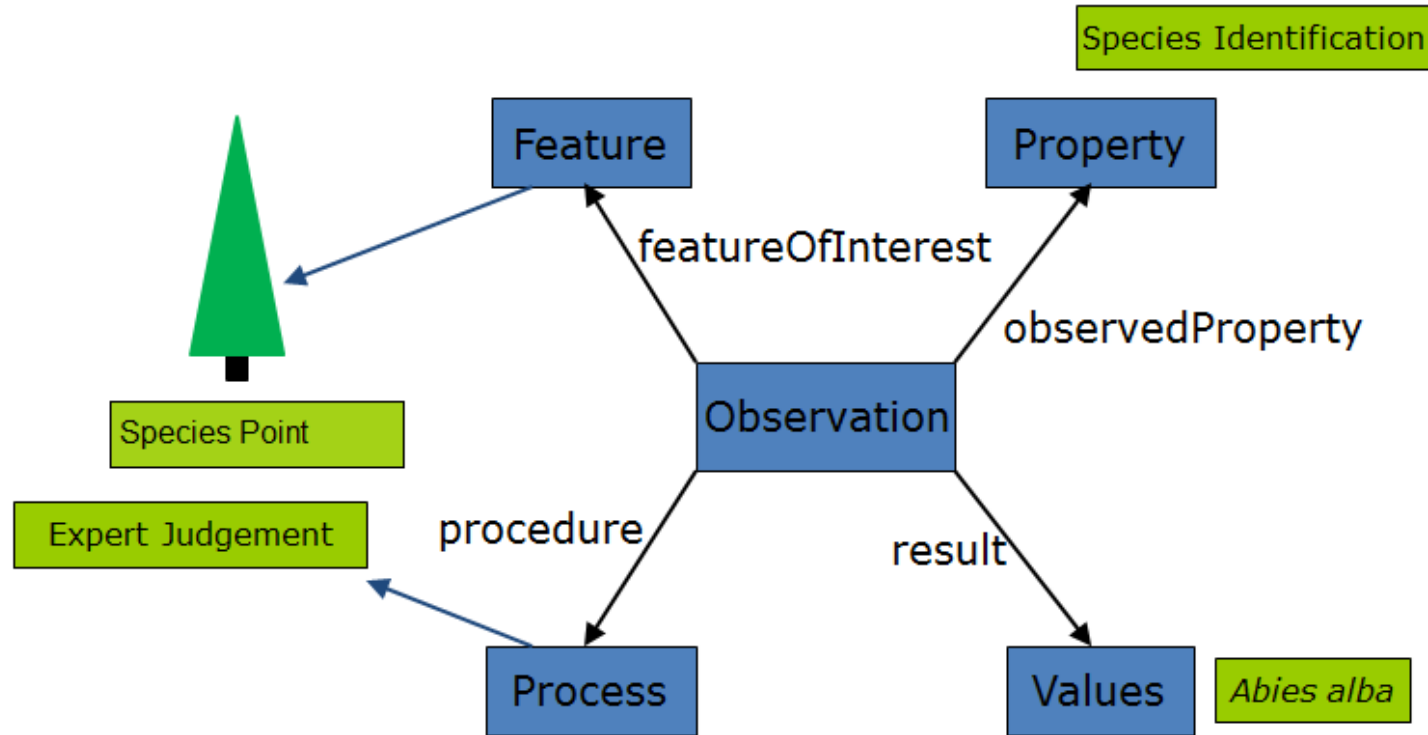
O&M Guidelines: Point - Multiple Results
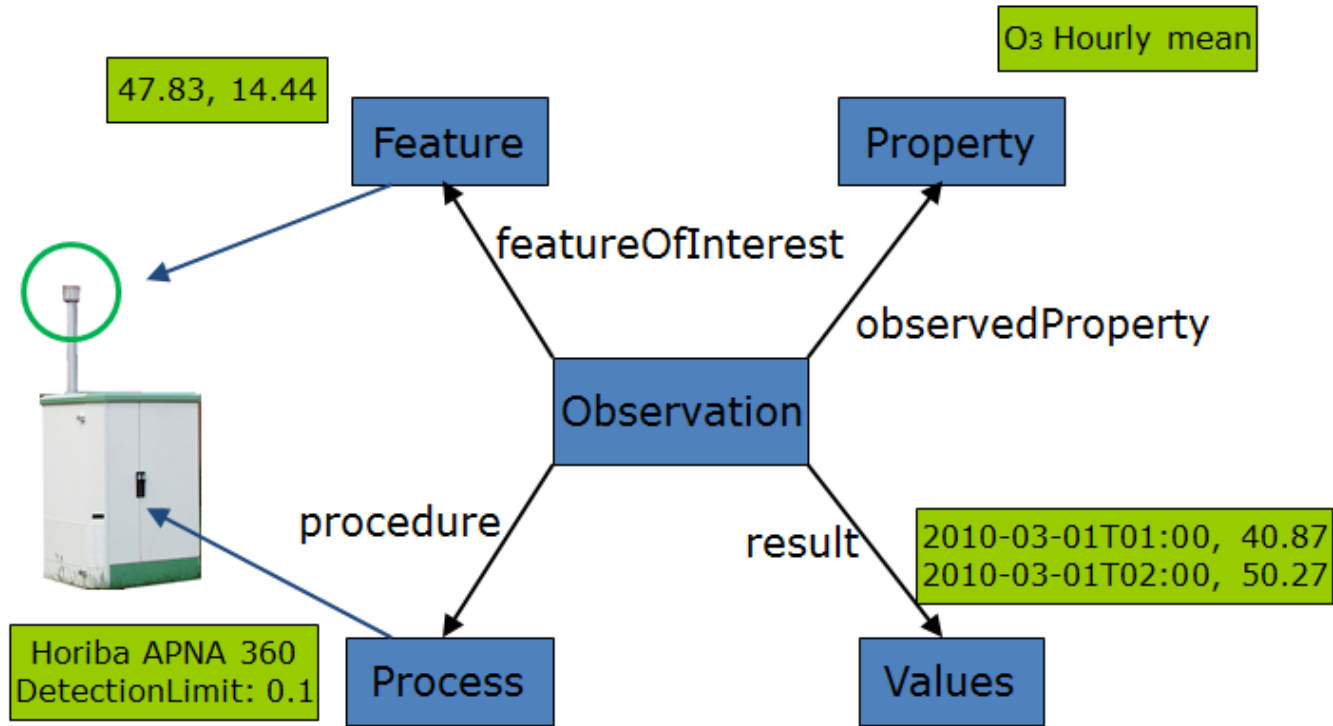
O&M Guidelines: Curve, single time
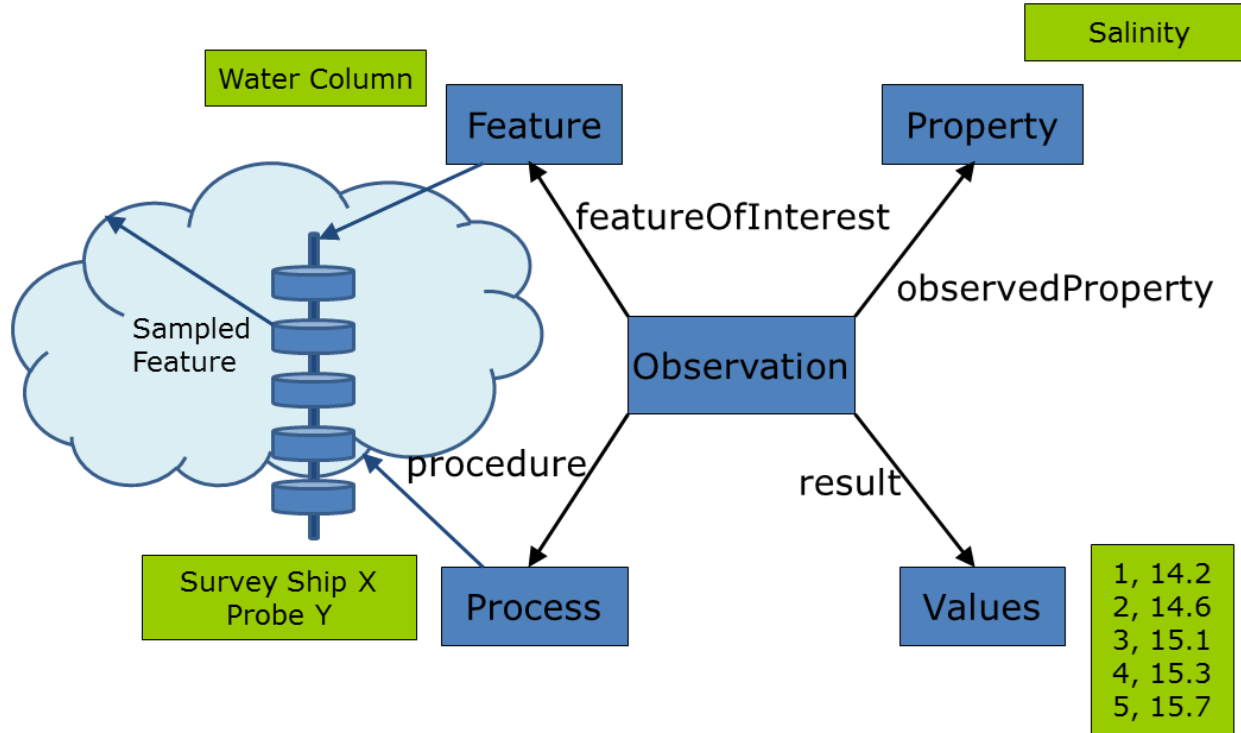
O&M Guidelines: Curve, multiple times
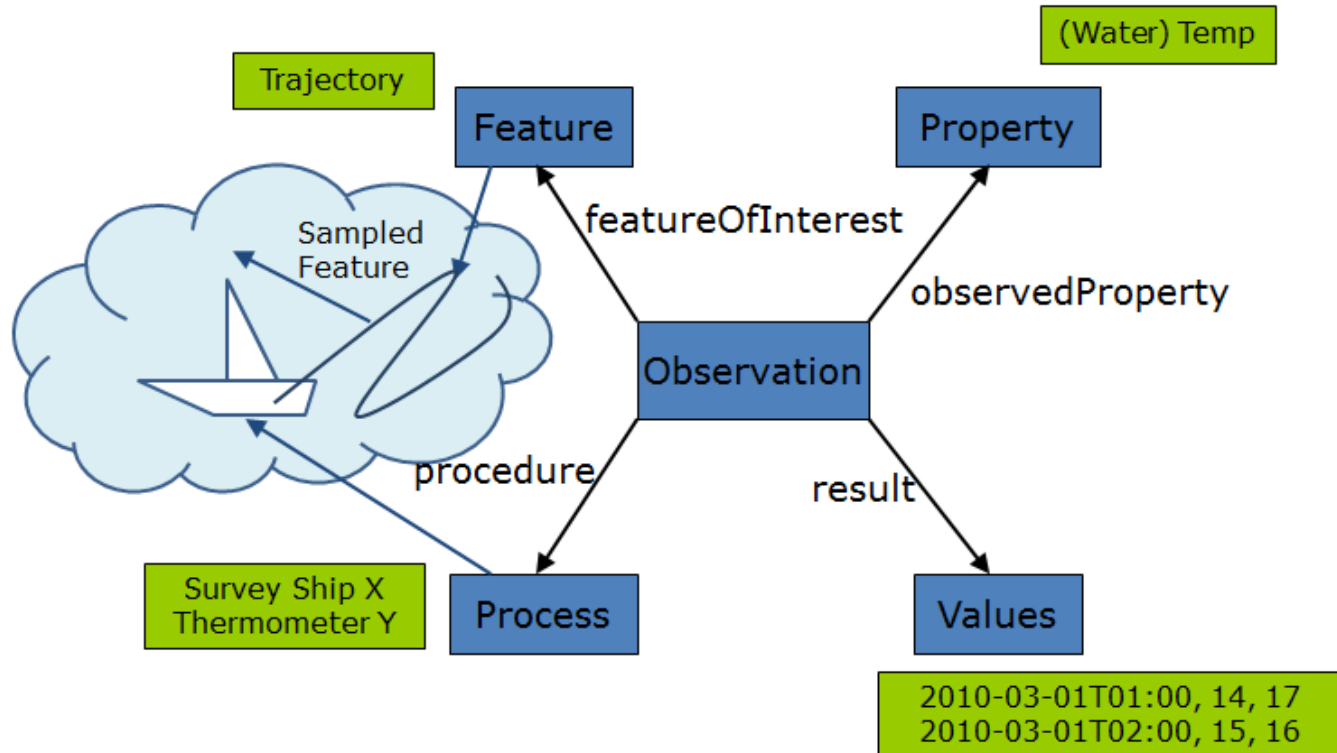
O&M Guidelines: Surface, single time
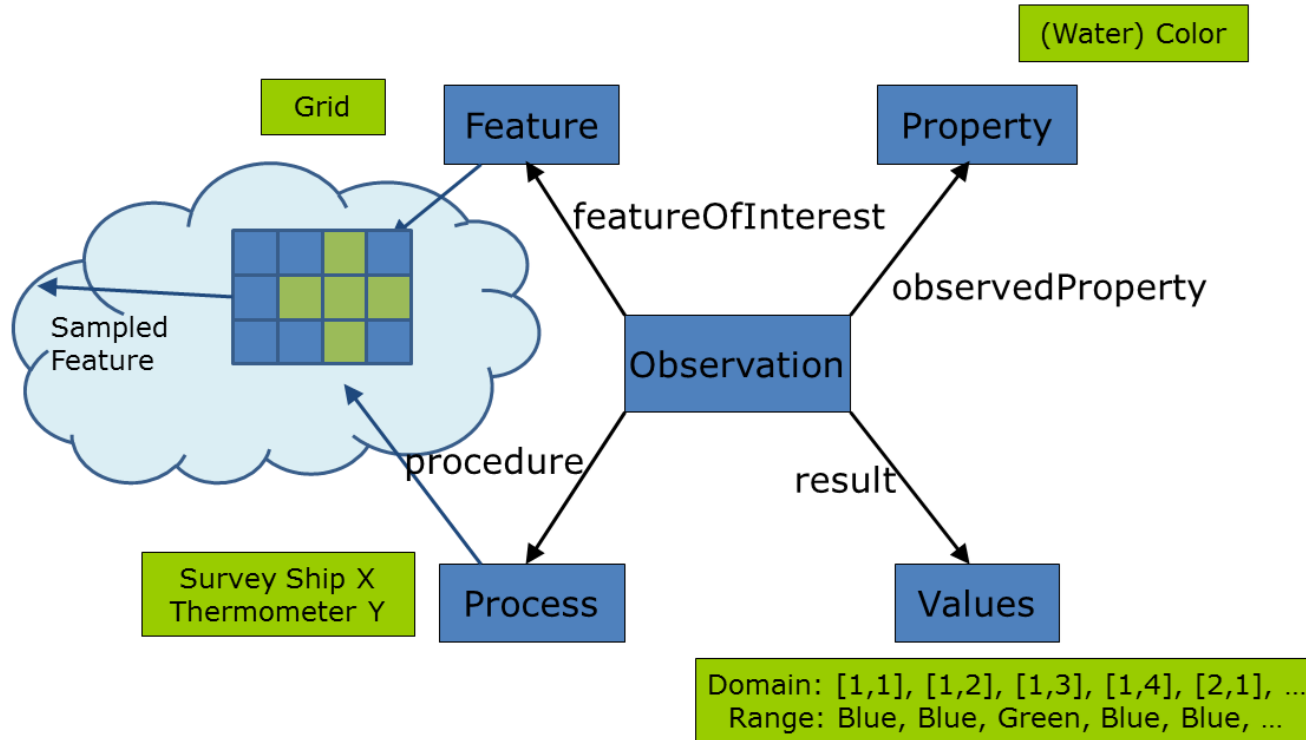
O&M Guidelines: Surface, multiple times
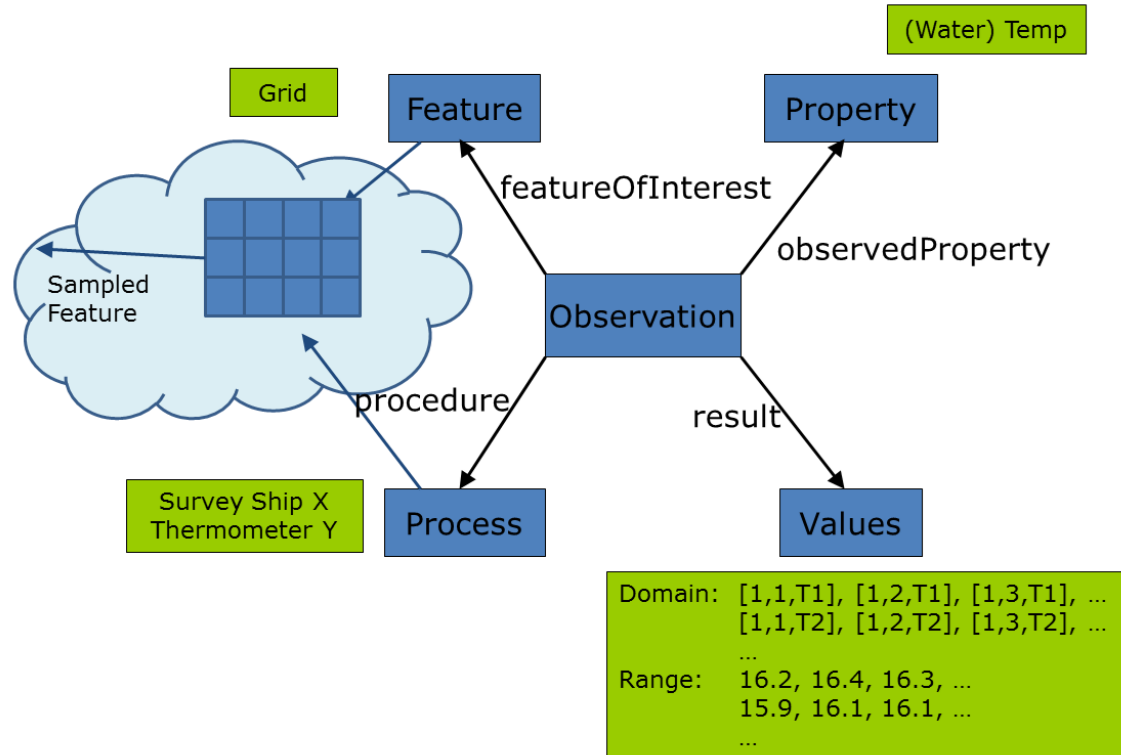
O&M Guidelines: Specimen, single time
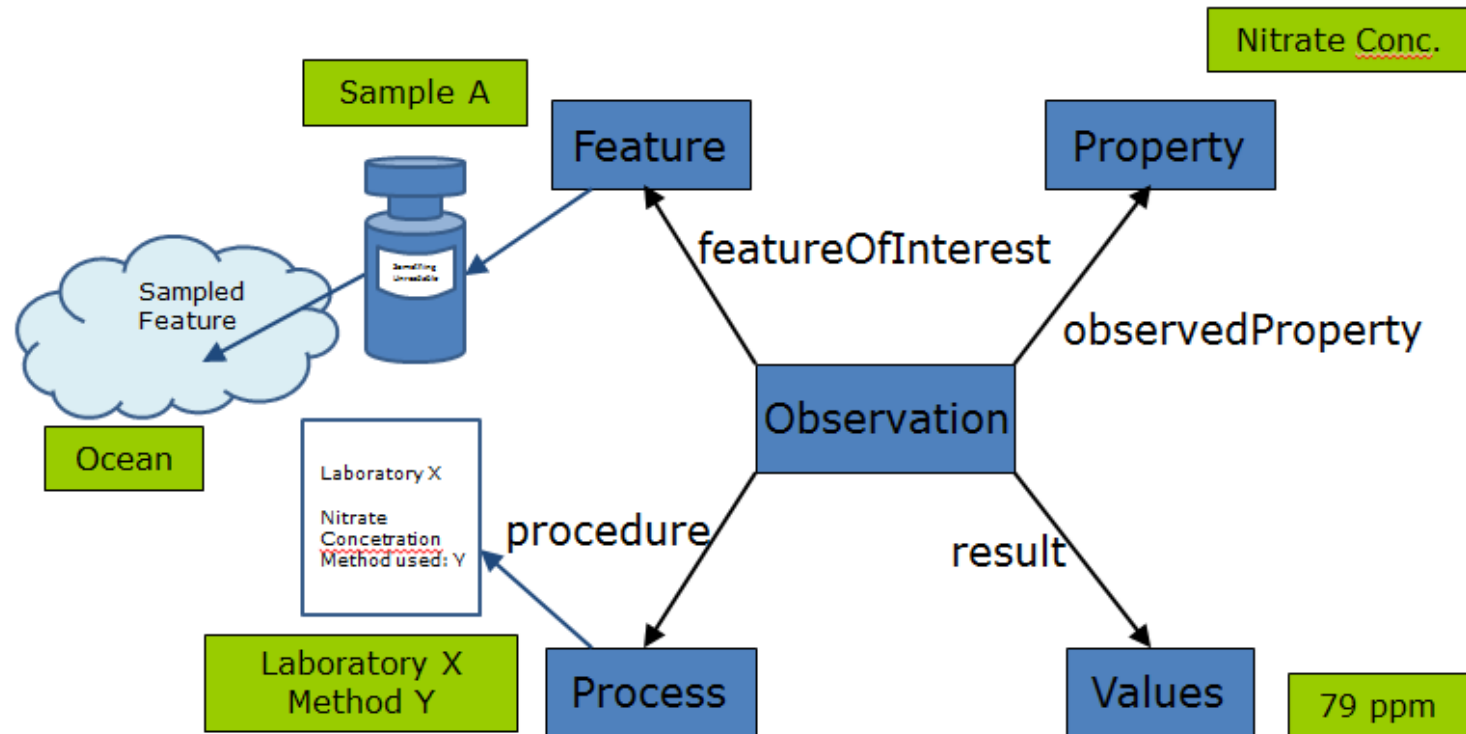
O&M Guidelines: Specimen, Multiple times
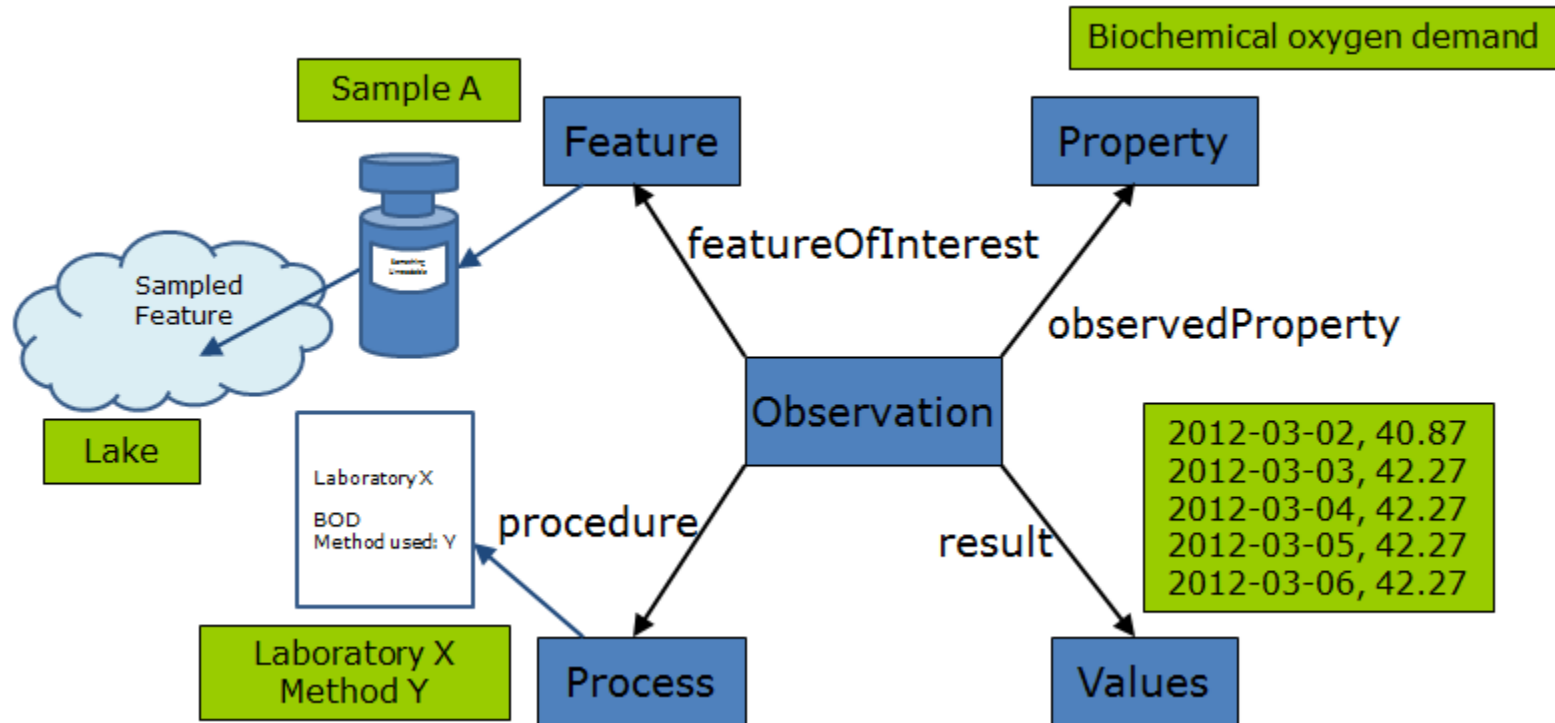
Extensions

AQD e-Reporting
- Air Quality Directive 2008/50/EC requires provision via INSPIRE
- INSPIRE EF and AM models have been extended accordingly
  - Reporting requirements added to data model
- AQD e-Reporting fulfills both INSPIRE and air quality requirements
- Other environmental reporting obligations to follow

Additionally
- National extensions based on national requirements
- OGC extensions (i.e. WaterML2.0, GroundWaterML2.0)

INSPIRE Thematic Clusters Platform

- EC initiative, linked to the INSPIRE Maintenance and Implementation Framework, with the objective of supporting INSPIRE implementation in the Member States.
- Officially launched on 11.12. 2014 as the INSPIRE Thematic user community collaborative platform
- Find good examples, best practices, useful tools, reference information
- Raise issues, share experiences, ask questions, ask and provide support

Thematic Clusters platform

https://themes.jrc.ec.europa.eu/

Environmental Monitoring and Observations Cluster

Environmental Monitoring Facilities

Observations and Measurements

What's inside

- Discussions
  - understanding and tailoring of the O&M model in INSPIRE,
  - how to use SOS services for environmental observations and measurements,
  - issues on identifiers and referencing
- Pages with best practices, references to presentations, tools etc.
- News, events

Useful reference information

▼ Group Pages

EF/O&M INSPIRE Conference presentations

EF/O&M Resources

EF/O&M Best practices

SOS Clients and Servers

Part 2. Implementations

52°North SOS INSPIRE Implementation

- ● 52n Standalone SOS
  - ○ Supported SOS standard versions: 1.0 + 2.0
  - ○ Flexible DB support, since based on Hibernate (e.g. PostGIS, Oracle Spatial)
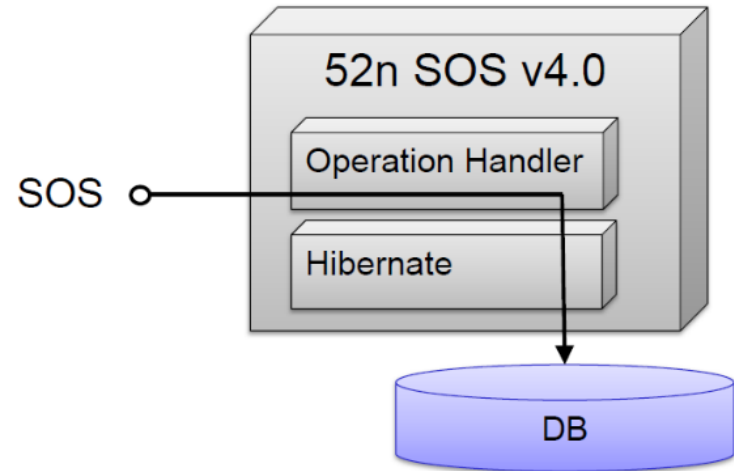
52°North SOS INSPIRE Implementation

- ## SOS Extension for ArcGIS Server
  - SOS standard version: 2.0
  - Flexible DB support, since based on ArcGIS Server + ArcSDE
  - Not yet fully INSPIRE compliant
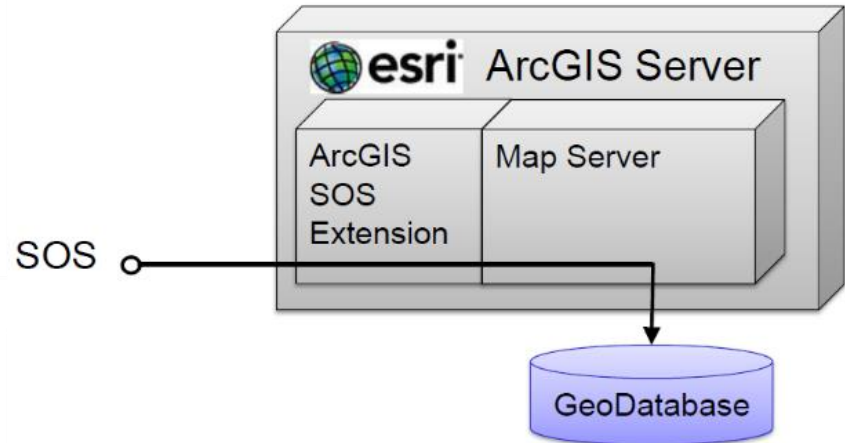
Member States using 52°North SOS

- Running
  - Sweden
  - Belgium
- Installation ongoing
  - United Kingdom
- Installation planned
  - The Netherlands
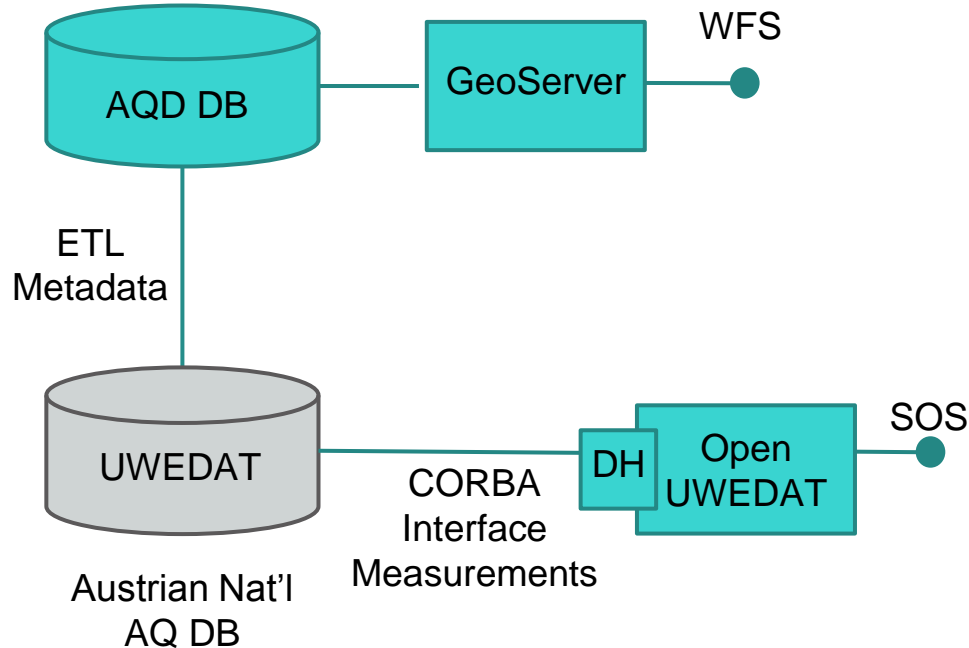 - Lithuania

52°North SOS INSPIRE Implementation
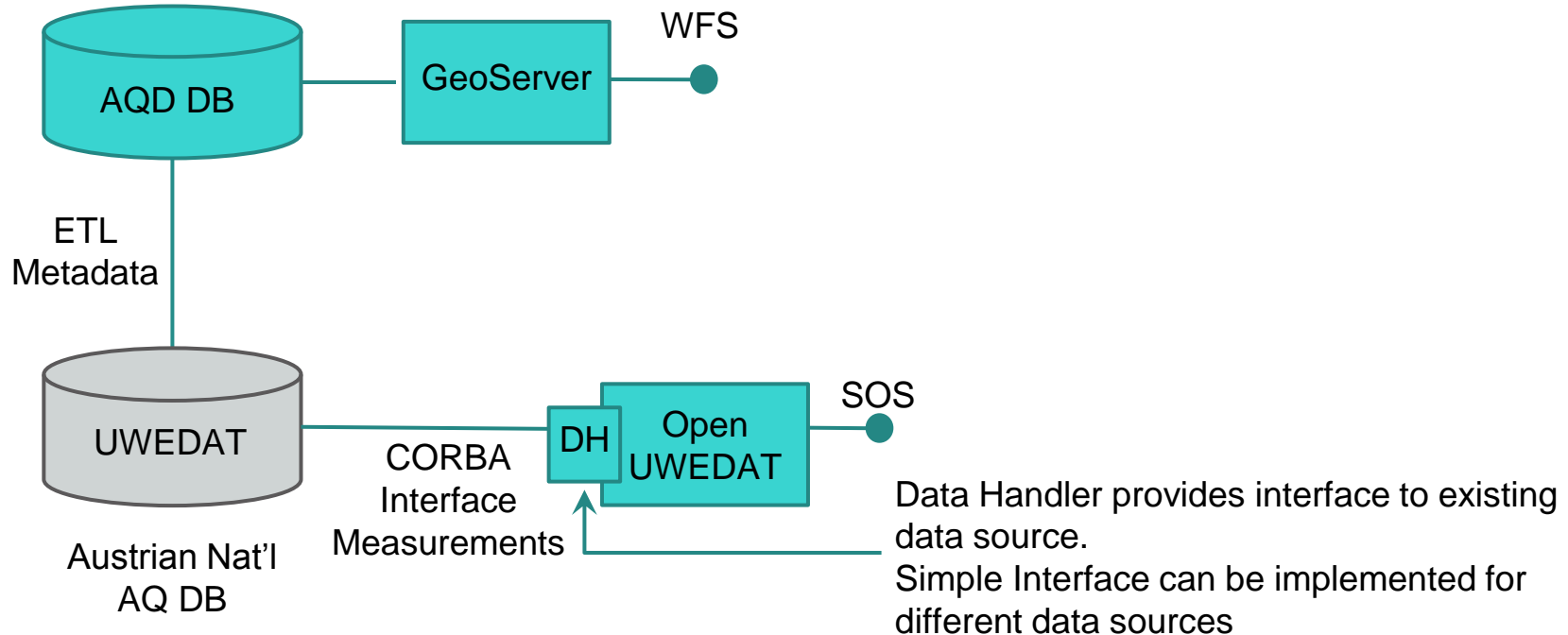
Brief live demo

Austrian AQD SOS implementation

UWEDAT
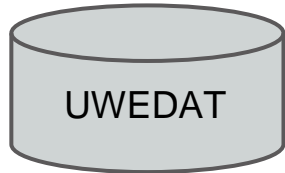
Austrian Nat'l
AQ DB

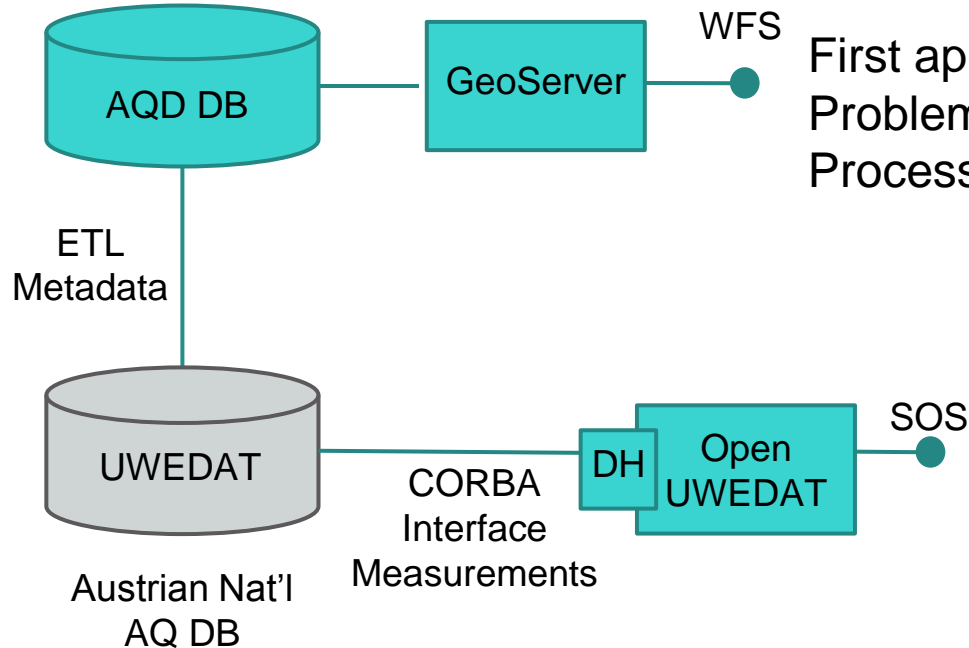# Austrian AQD SOS implementation

Austrian AQD SOS implementation

AQD DB

GeoServer

WFS

ETL
Metadata

UWEDAT

Austrian Nat'l
AQD DB

CORBA
Interface
Measurements

DH

Open
UWEDAT

SOS

Data Handler provides interface to existing data source.
Simple Interface can be implemented for different data sources

Austrian AQD SOS implementation

Data Handler Class must be adapted in the following methods:

- Setter methods to parameterize data source connection
- Open & Close methods
- Filter methods to specify specific data point (~ ObservingCapabilities).
- getTimeSeries

TimeSeries class must be configured in accordance with data to be served

Austrian AQD SOS implementation

First approach
Problem: how to keep featureOfInterest and Process aligned between WFS and SOS

Austrian AQD SOS implementation
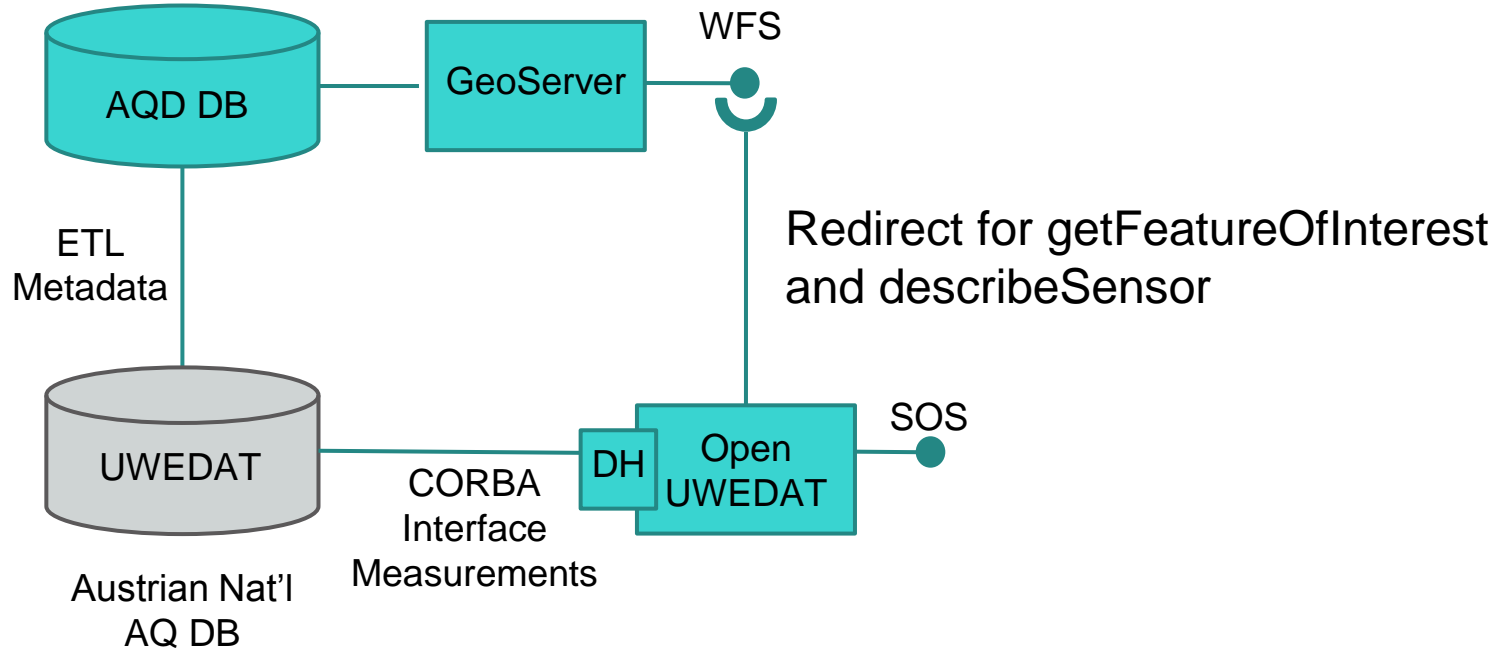
SWEing French groundwater level monitoring

2 approches
next to another

GPRS connected
automatic sensor

Manual sensor and
hydrogeologist handbook

SWEing French groundwater level monitoring

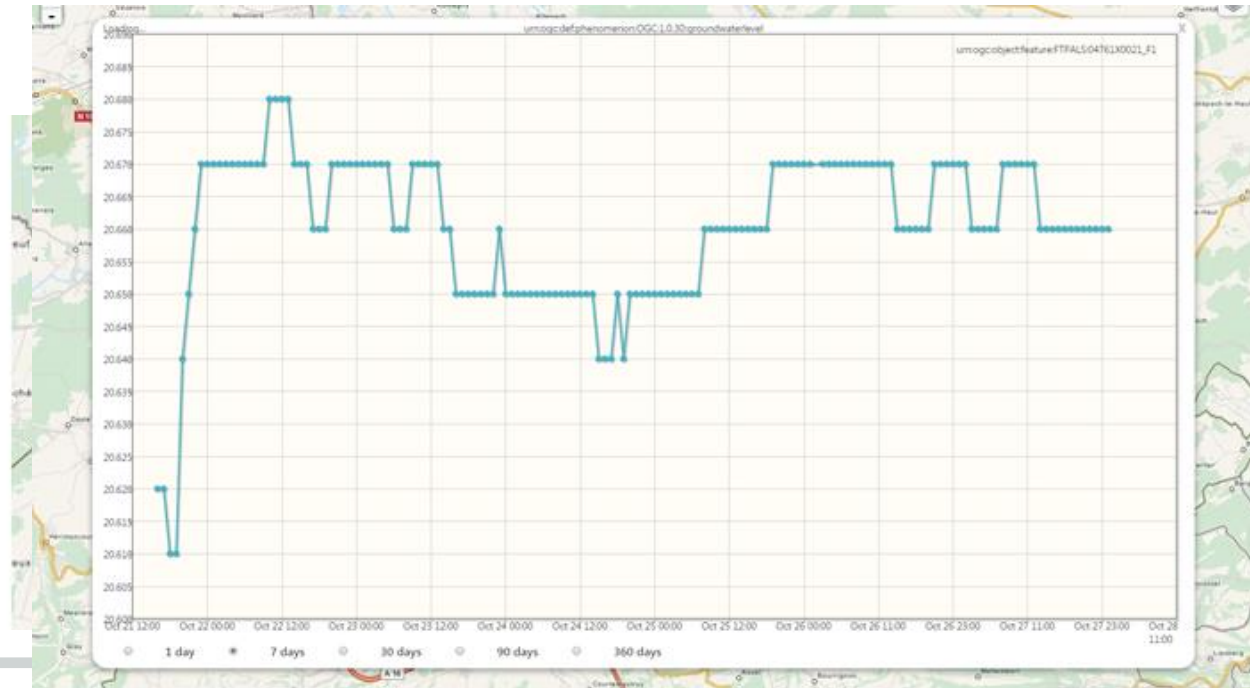## One pivotal exchange mechanism/format

- SOS 2.0 output, WaterML2.0 encoding
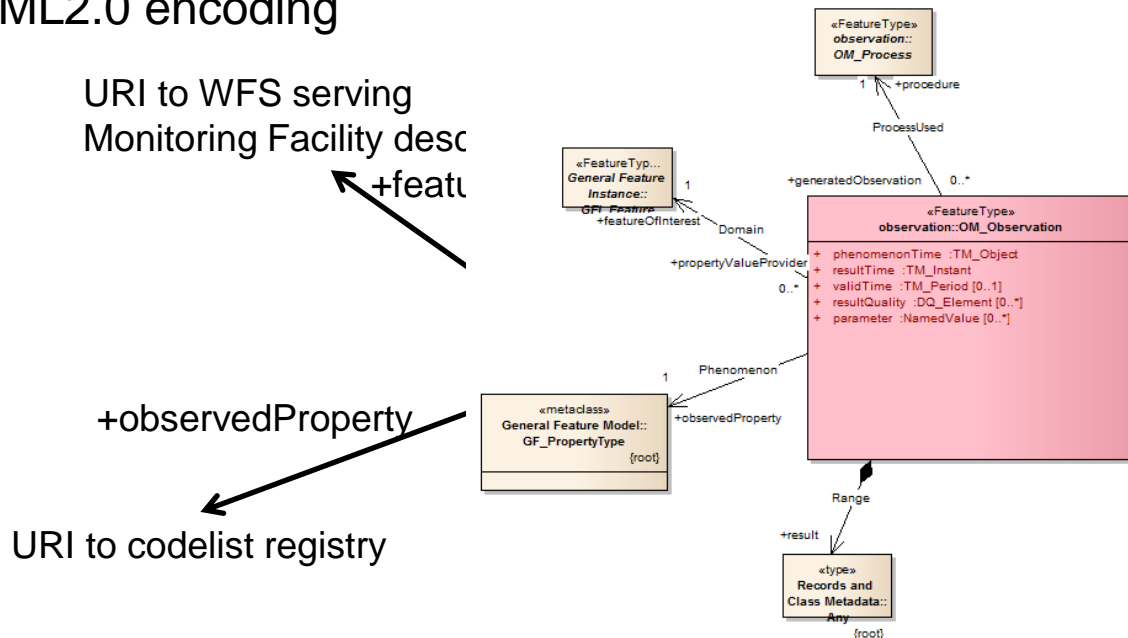
SWEing French groundwater level monitoring

Several output platforms

- Website

SWEing French groundwater level monitoring

Several output platforms

- Mobile

- Desktop : QGIS plugin SOS tested

And plenty of possible cross-domain reuse

- Drought forecast
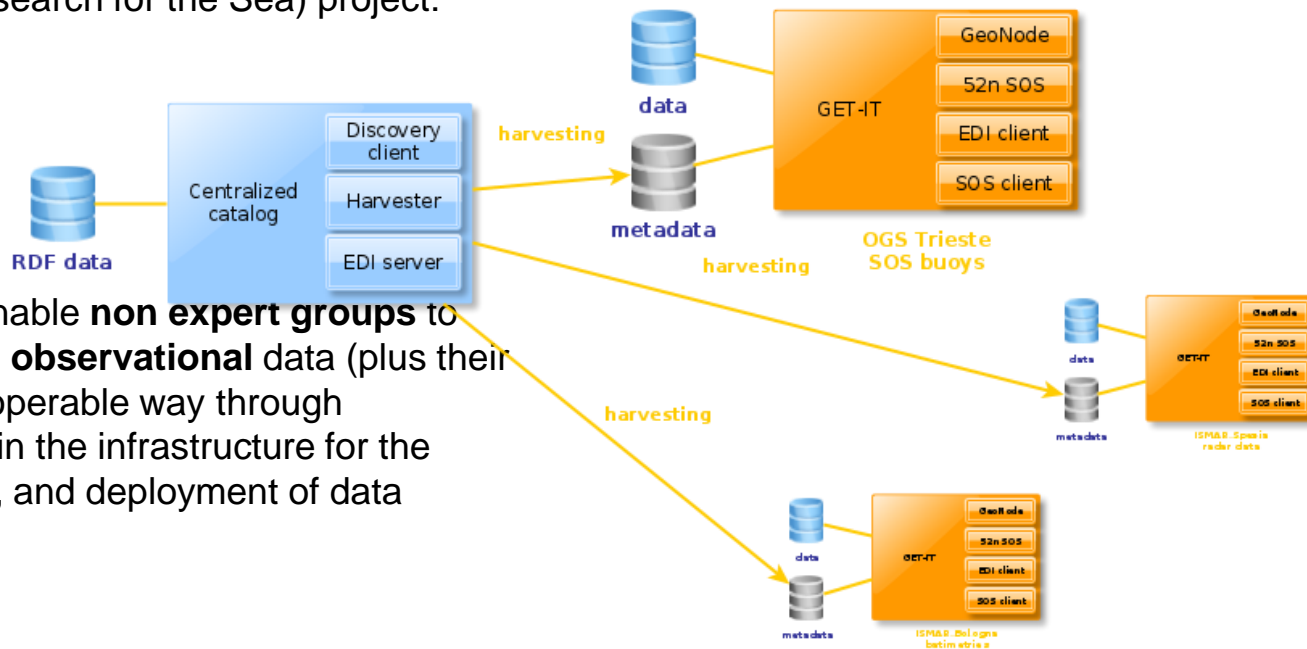

Groundwater level current values

Season threshold

Forecast

!! Drought warning !!
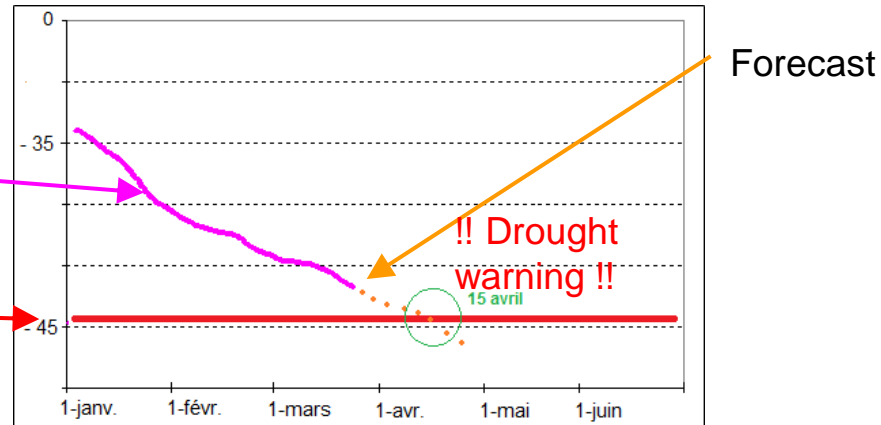
- Flood forecast

- Geothermy monitoring
    - Groundwater influence in geothermy platforms

GET-IT: GeoEnabling Information Toolkit

Open source software suite developed inside the RITMARE (Italian Research for the Sea) project: www.ritmare.it.

The main goal is to enable **non expert groups** to serve **geospatial** and **observational** data (plus their metadata) in an interoperable way through **autonomous nodes** in the infrastructure for the collection, annotation, and deployment of data
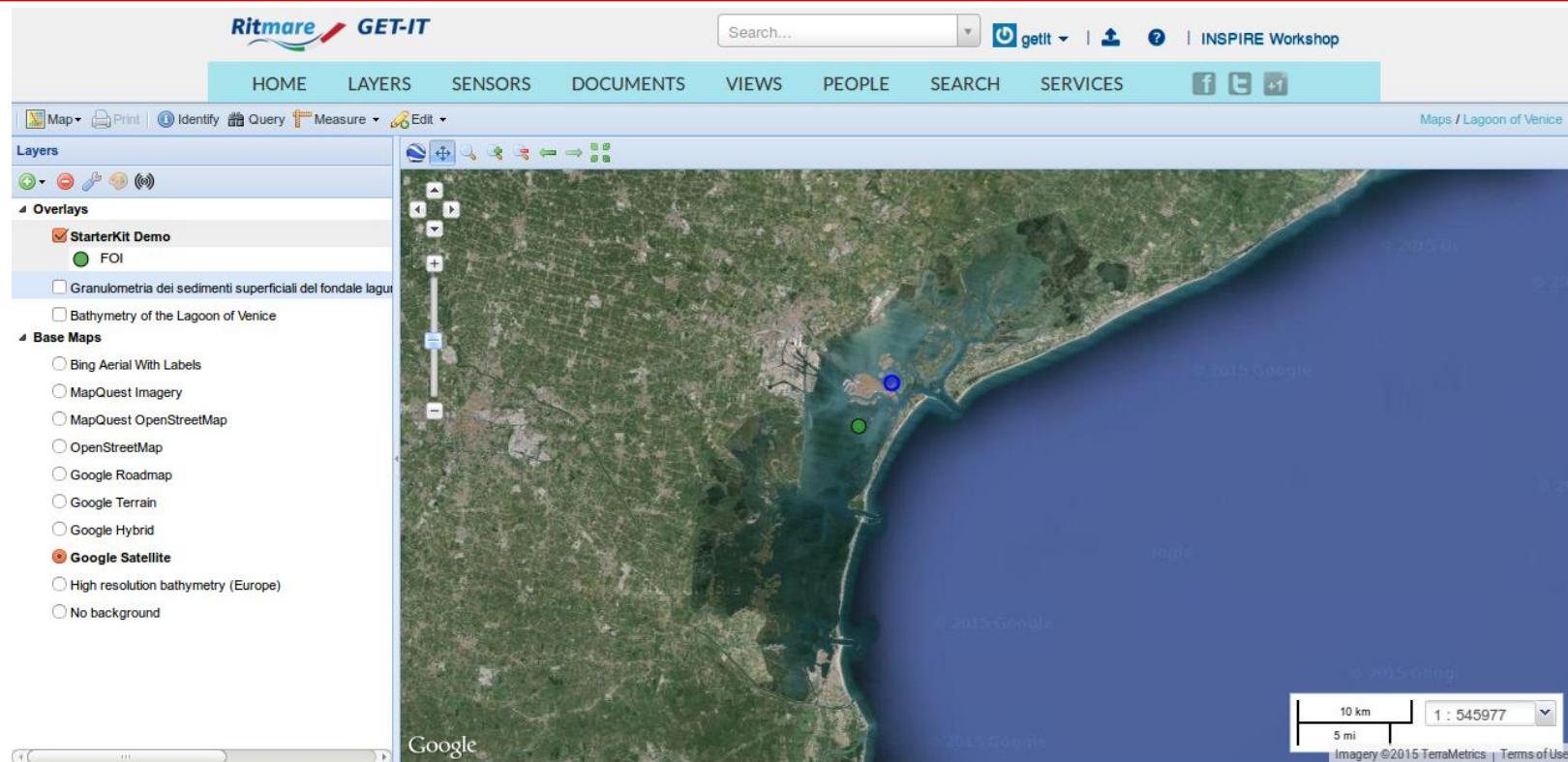
GET-IT: GeoEnabling Information Toolkit

Supporting researchers
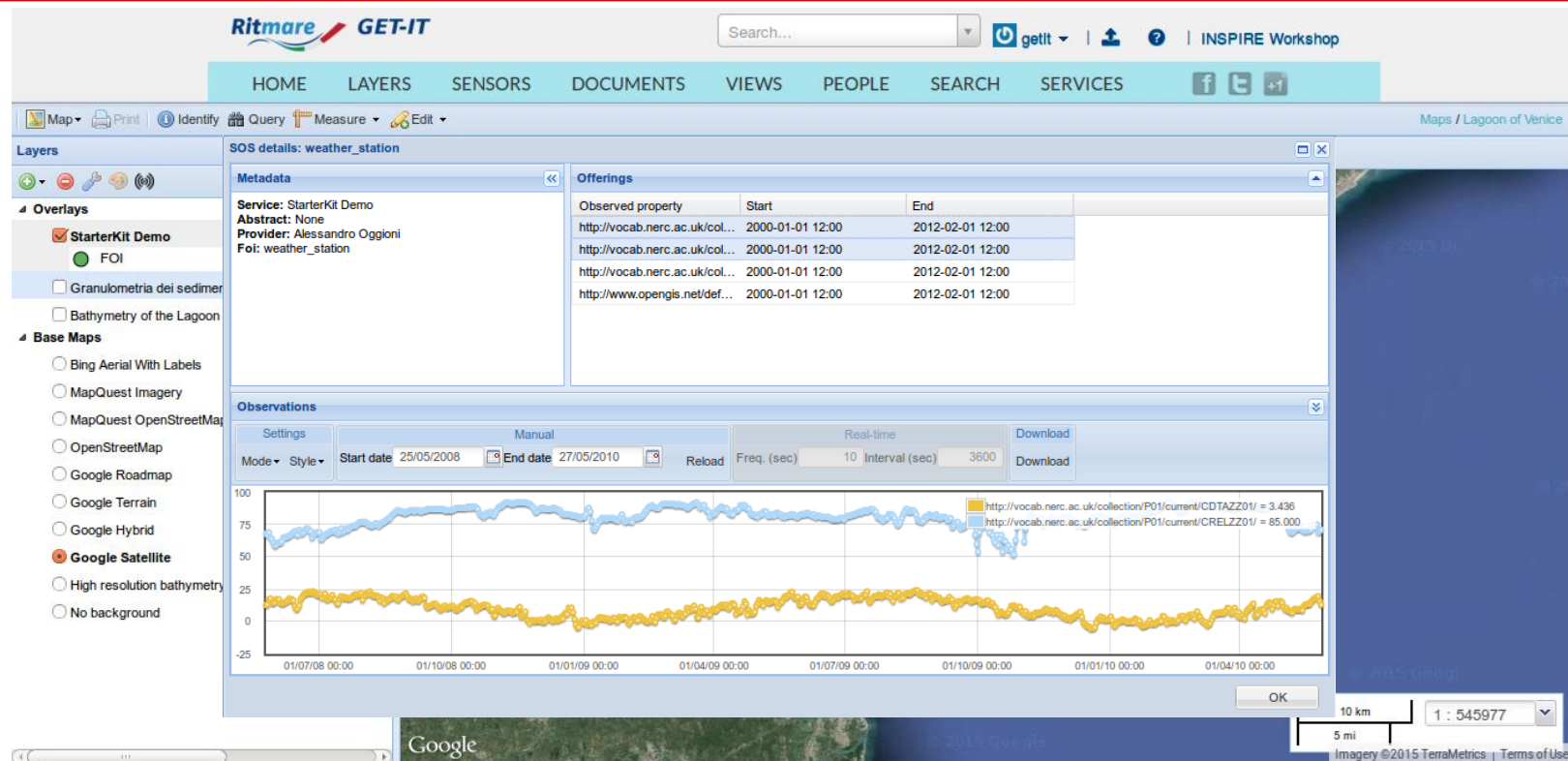to insert observations.
Use cases in RITMARE:
- real-time observations from sensors
- manually recorded observations

SOS

sos:insertObservation

sos:insertObservation
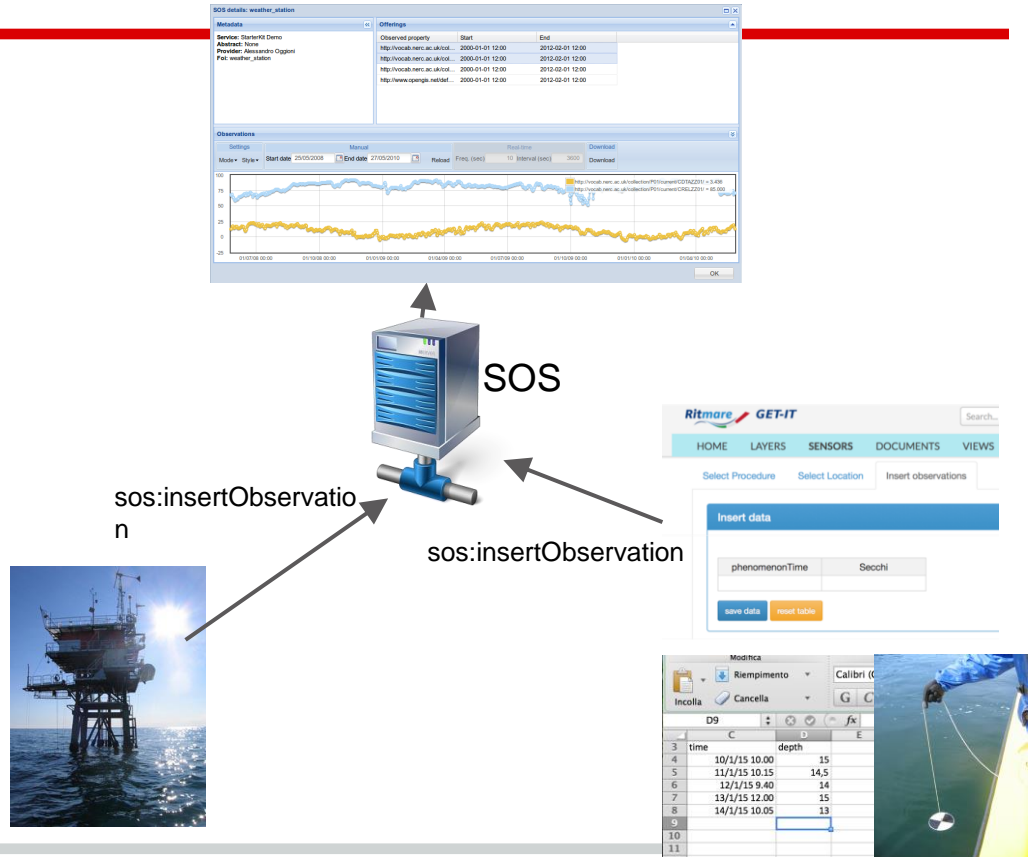
SOS Client Interface

SOS Client Interface

Server

- 52°N
- Austrian AIT
- Geomatys
- IST-SOS
- Kisters
- + several ad-hoc solutions

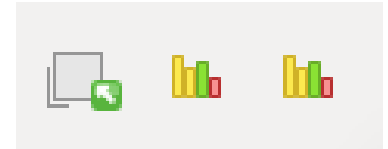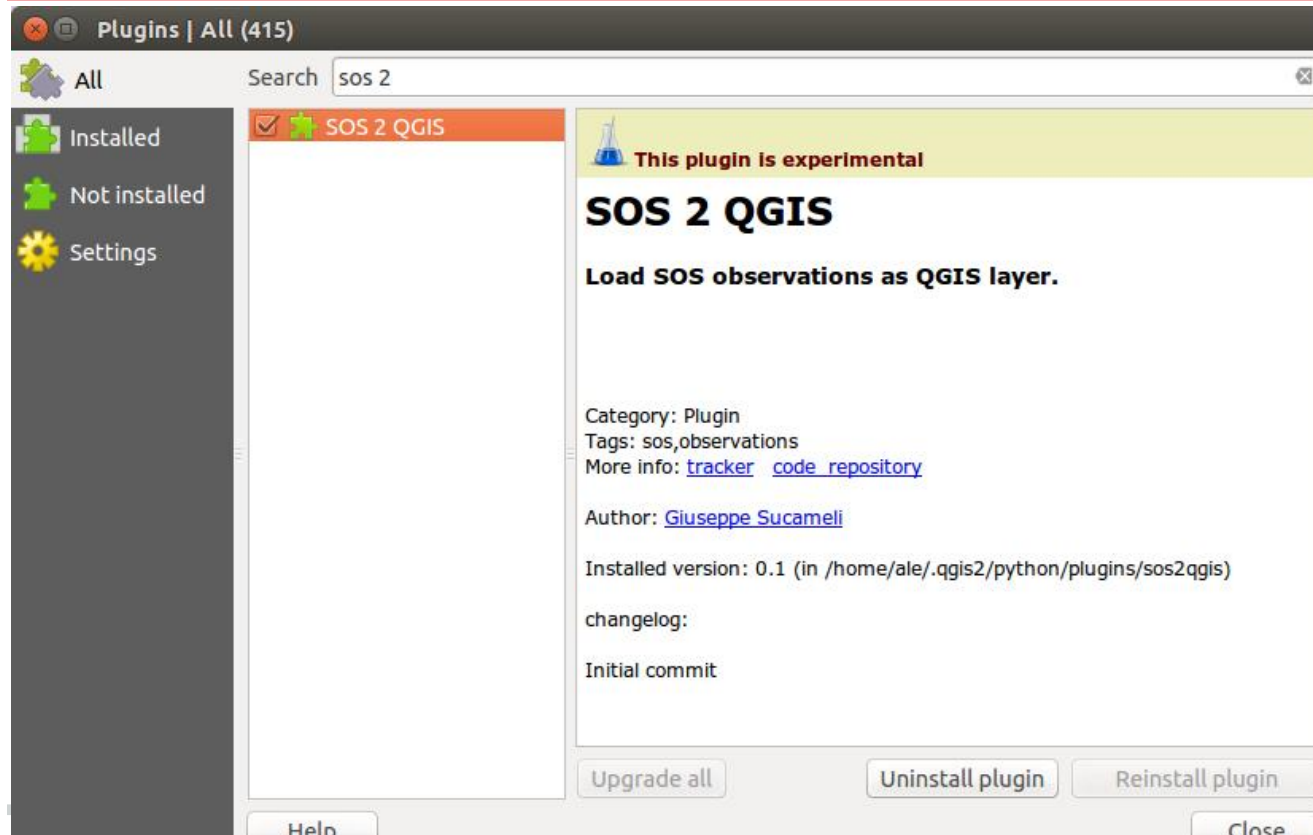# Client

- QGIS Plugin
- Web Clients (52°N & IST)
- Kisters
- 52°N Lightweight for Mobile
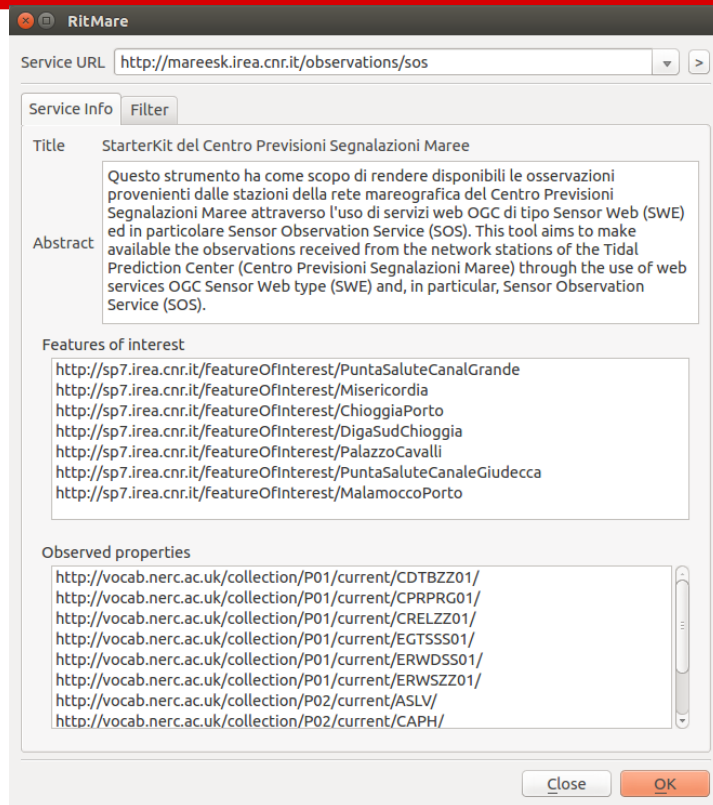- GET-IT web js clients (vis. & transactional)

SOS2QGIS

- Python plugin to connect to SOS and visualise and use SOS-data in QGIS
- Developed by Giuseppe Sucameli, with the supervision of Alessio Bechini, Univ. of Pisa
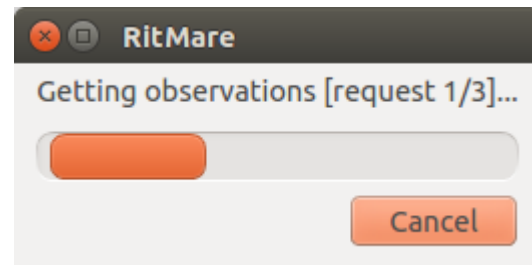- CNR-ISMAR is helping providing use cases and testing

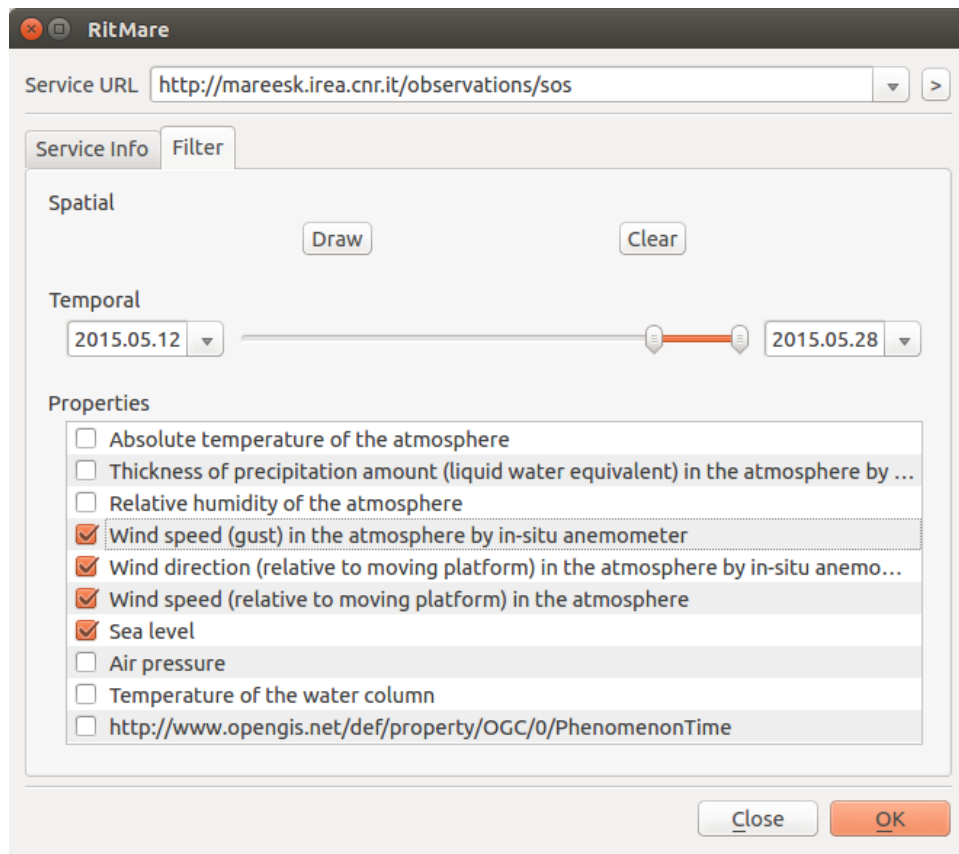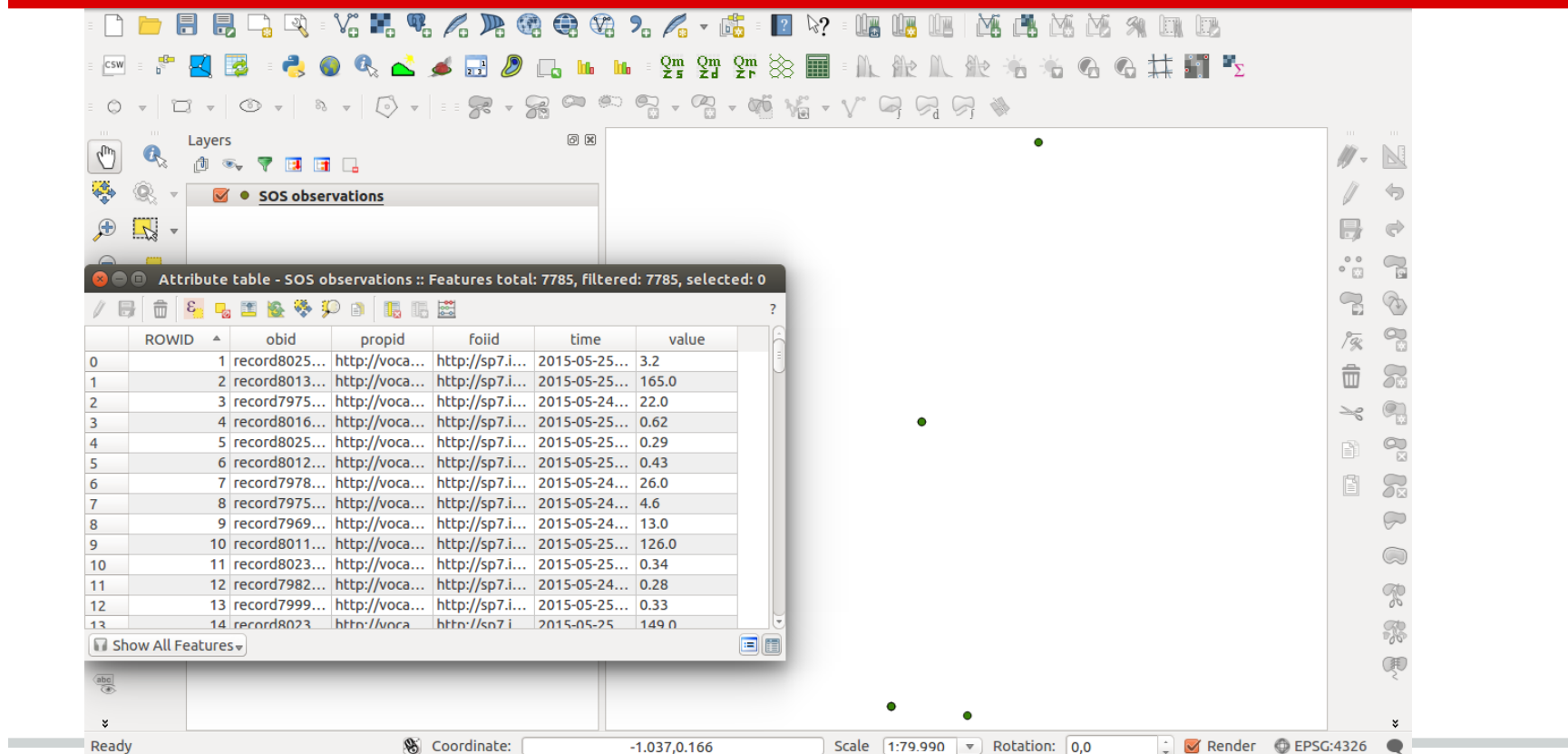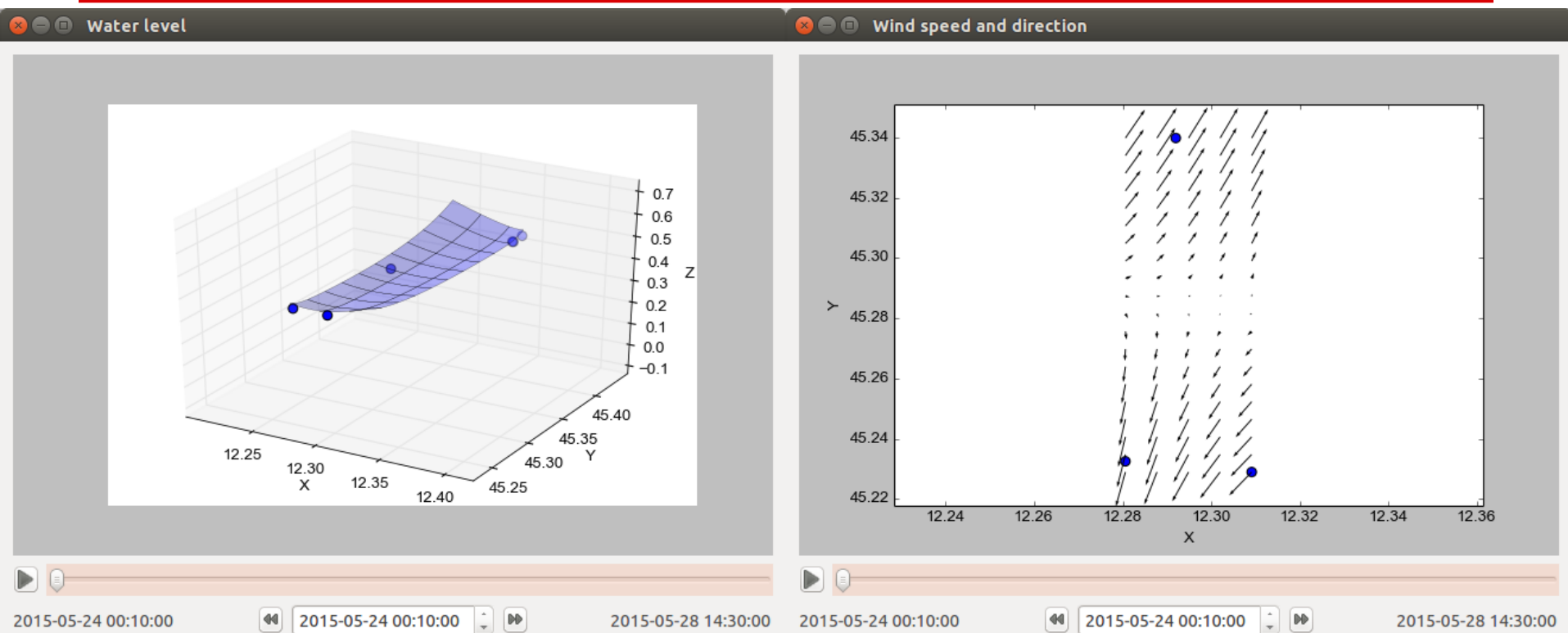# Install the plugin

SOS GetCapabilites

Select Properties and create Spatialite DB

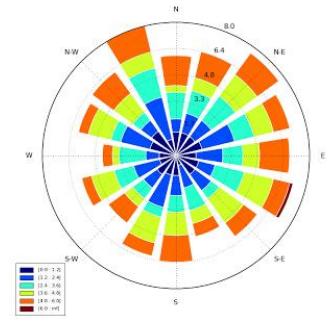# Visualize FOIs and values

Static and dynamic graphics

To do

- 2D xy graph with multiple properties, multiple FOIs
- Other types of data: e.g. windrose

- What are your requirements?
  - Domain (property) specific
  - Use case specific

Providing INSPIRE measurement data

Thanks for your attention!