Providing INSPIRE measurement data

K. Schleidt, S. Grellet, A. Sarretta, P. Tagliolato, A. Kotsev

Part 1. Introduction



- 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



- 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
 - o terabytes of temporal data





- 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):
 - $\circ~$ 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

To understand the data from an observation or measurement, we must know:

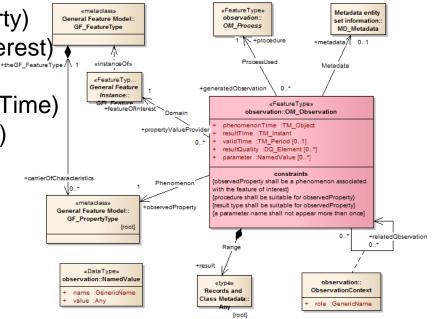
- What was measured (observedProperty)
- Where was it measured (featureOfInterest)
- How was it measured (procedure)
- When was it measured (phenomenonTime)
- Data quality information (resultQuality)

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

To understand the data from an observation or measurement, we must know:

- What was measured (observedProperty)
- Where was it measured (featureOfInterest)²
- How was it measured (procedure)
- When was it measured (phenomenonTime)
- Data quality information (resultQuality)

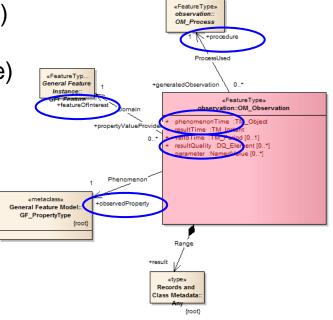
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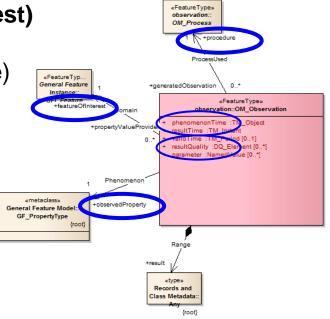
And of course, we need the result of the observation.



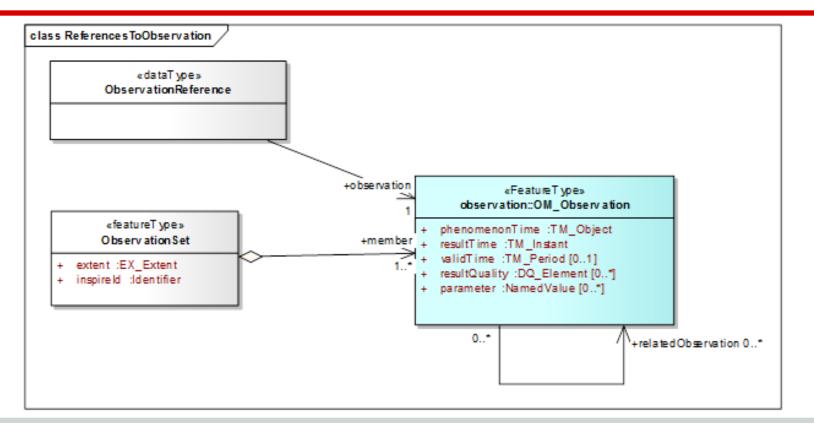
To understand the data from an observation or measurement, we must know:

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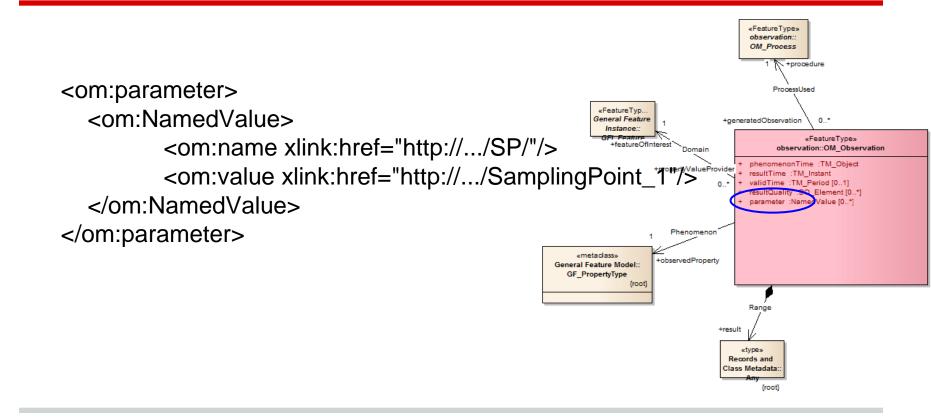
And of course, we need the result of the observation. Note: parts already provided with EF Facility



Feature Referencing Observations

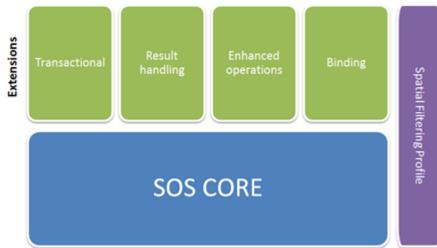


Observation Referencing Feature



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:

GetCapabilities

DescribeSensor

GetObservation

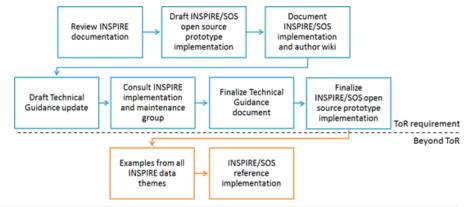
2.

3.

Sensor Observation Service 1.: Water_level > 500 cm: SMS 2.: Wind speed > 20 m/s & Wind direction = NW: E-Mail subscribe & specify filter request data submit task notify (e.g. SMS) SOS SES WNS SPS trigger alarm observations commands data stream Extensions SOS Core - Operations: **GetCapabilities** DescribeSensor 3. **GetObservation** SOS CORE

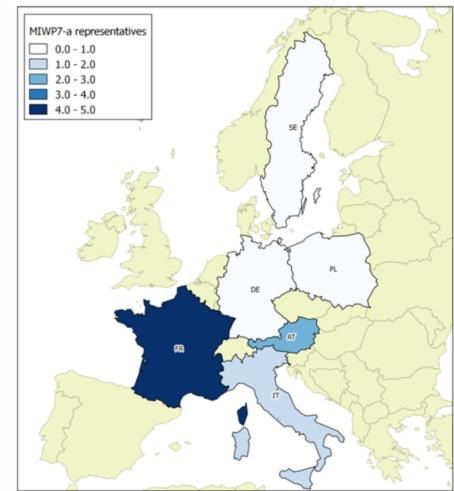
SOS as an **INSPIRE** Download Service

- 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"

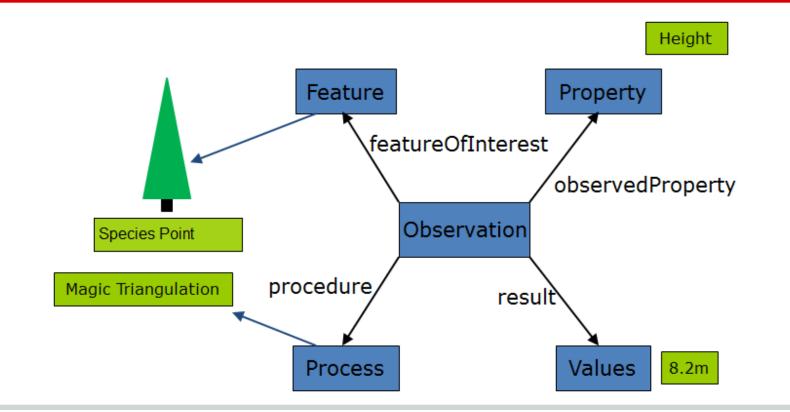
- Members of the sub-group:
 - Member State representatives: 13
 - Environmental agencies
 - Research
 - Private sector
 - JRC: 2
 - Represented domains:
 - Air quality (AT, IT)
 - · Geology and Soil (FR, SE)
 - Marine& Meto (IT, AT, FR)



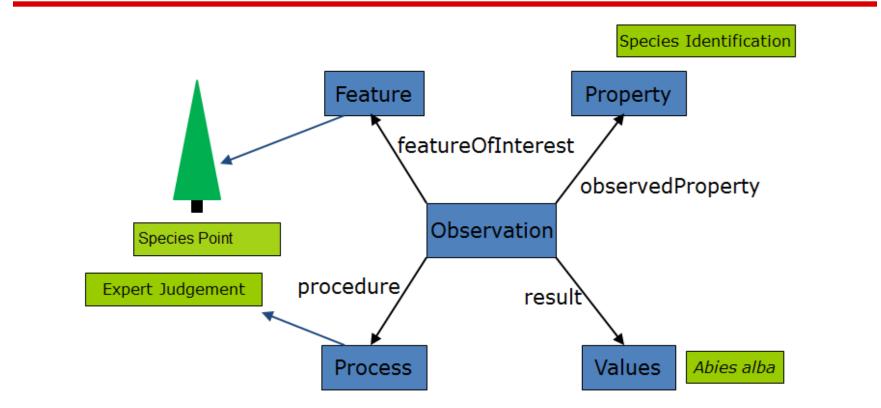
O&M Guidelines

- 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

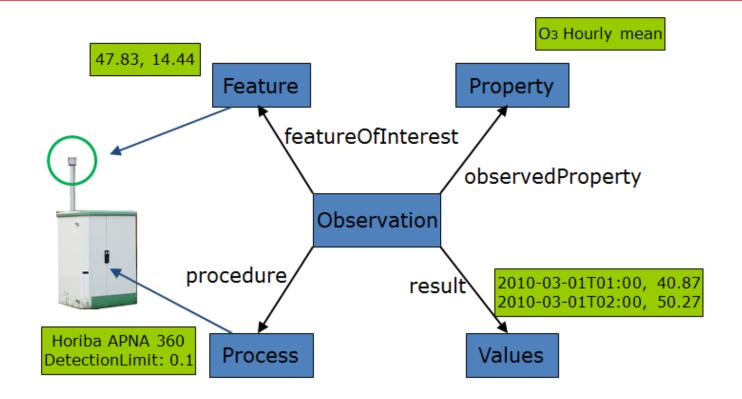
O&M Guidelines: Point - Single Result



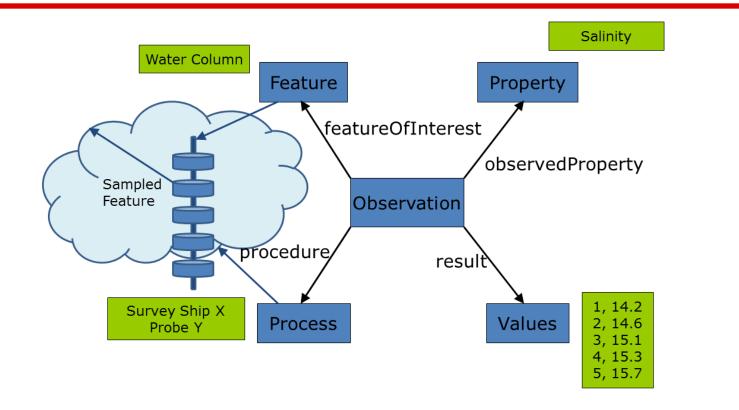
O&M Guidelines: Point - Single Result



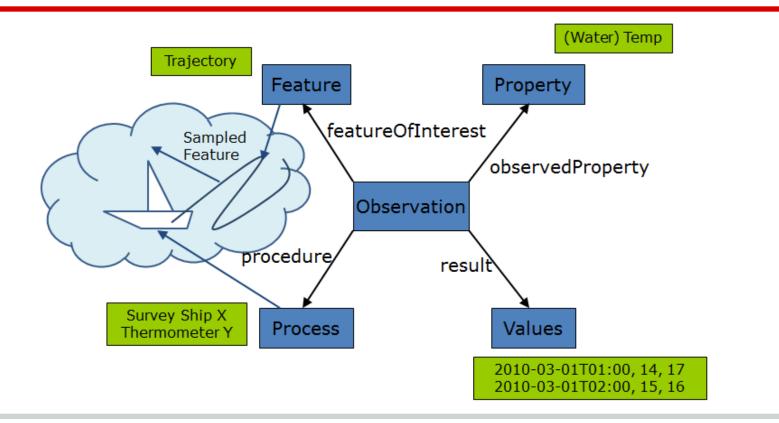
O&M Guidelines: Point - Multiple Results



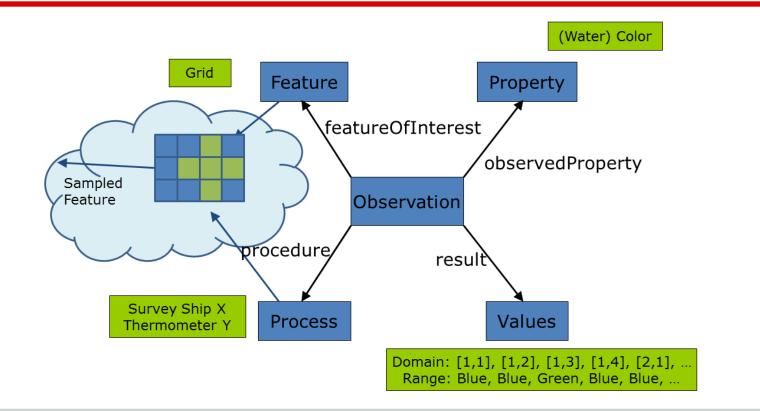
O&M Guidelines: Curve, single time



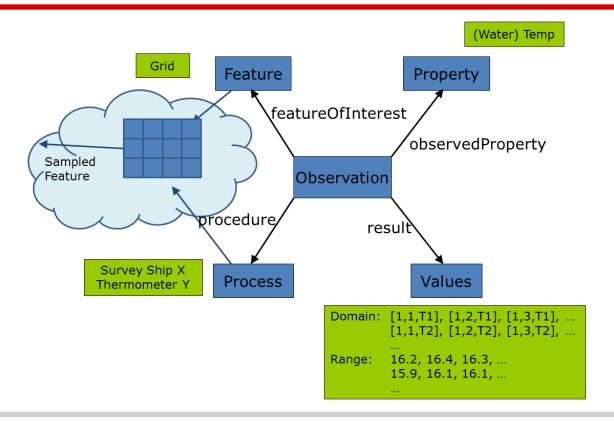
O&M Guidelines: Curve, multiple times



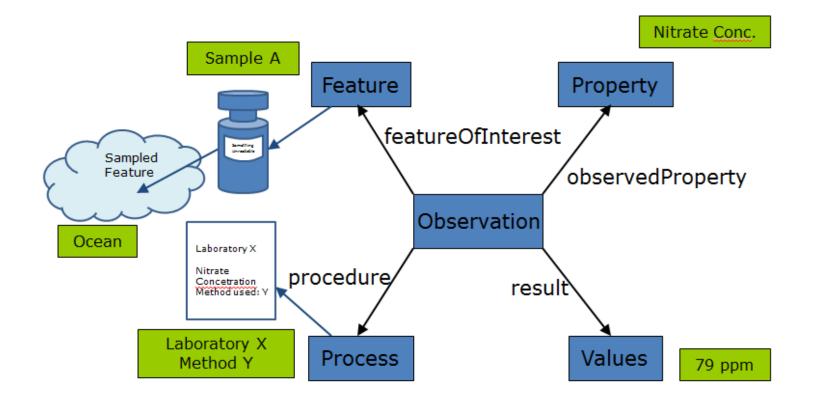
O&M Guidelines: Surface, single time



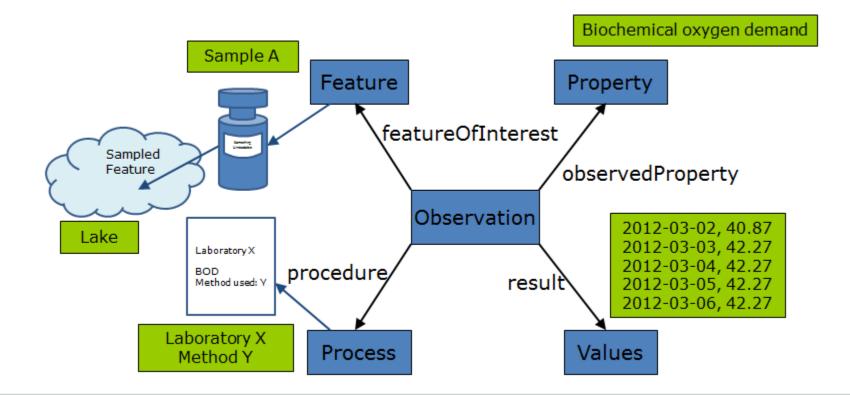
O&M Guidelines: Surface, multiple times



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,
- \circ 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

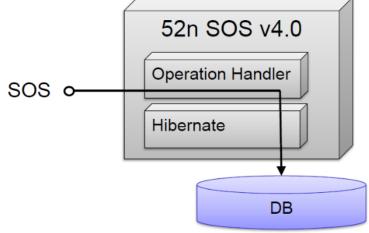
SOS Clients and Servers

Part 2. Implementations

52°North SOS INSPIRE Implementation

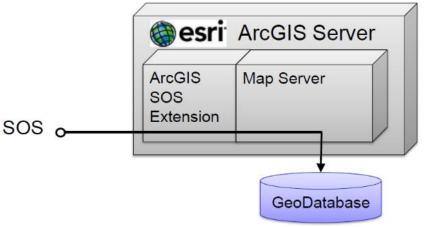
• 52n Standalone SOS

- 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
 - $_{\circ}$ SOS standard version: 2.0
 - Flexible DB support, since based on ArcGIS Server
 + ArcSDE
 - Not yet fully INSPIRE compliant

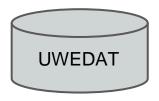


Member States using 52°North SOS

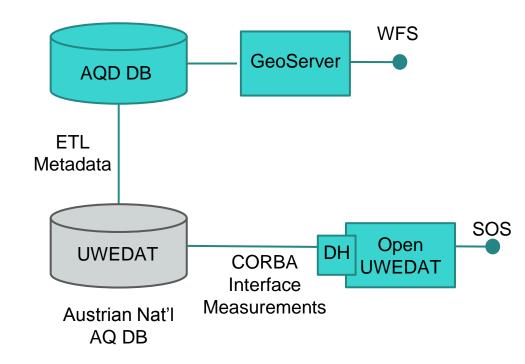
- Running
 - \circ Sweden
 - o Belgium
- Installation ongoing
 - United Kingdom
- Installation planned
 - The Netherlands
 - o Lithuania

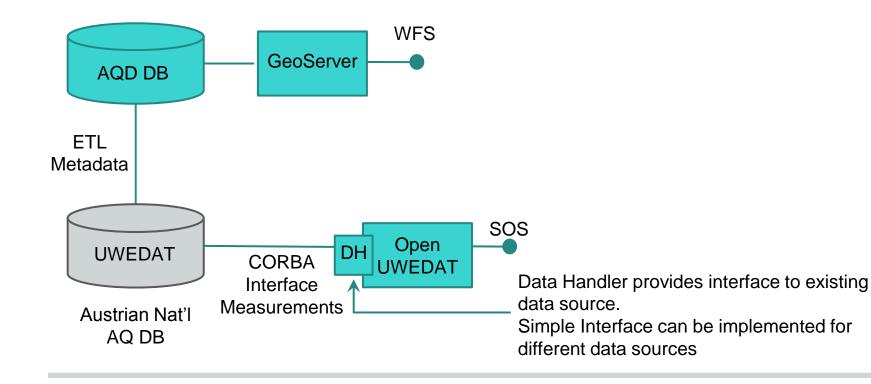
52°North SOS INSPIRE Implementation

Brief live demo



Austrian Nat'l AQ DB

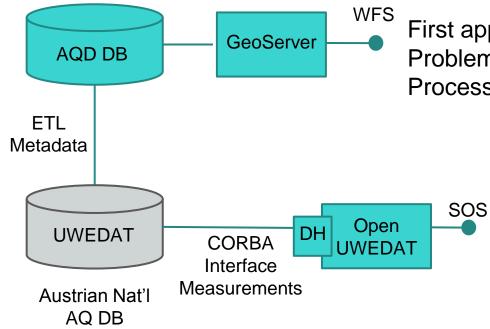




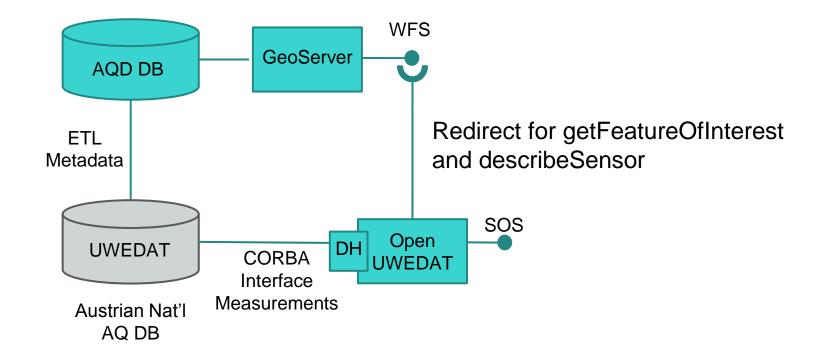
Data Handler Class must be adapted in the following methods:

- 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



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



2 approches next to another

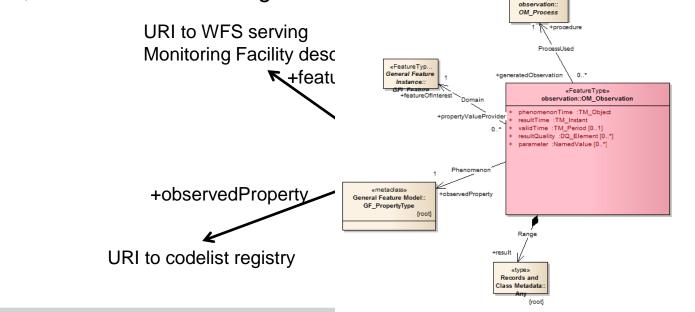
GPRS connected automatic sensor



Manual sensor and hydrogeologist handbook

One pivotal exchange mechanism/format

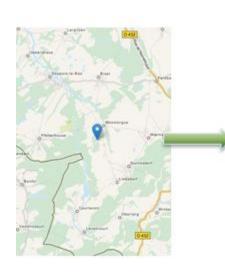
• SOS 2.0 output, WaterML2.0 encoding



«FeatureType»

Several output platforms

• Website

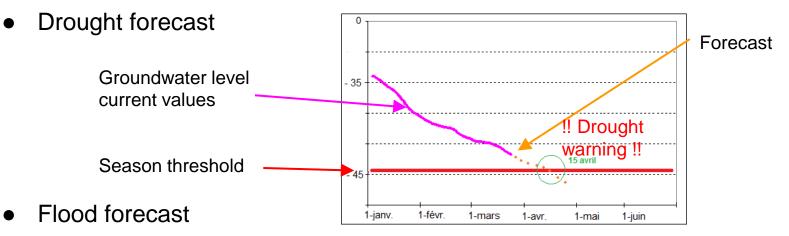




Several output platforms

- Mobile
- Desktop : QGIS plugin SOS tested

And plenty of possible cross-domain reuse



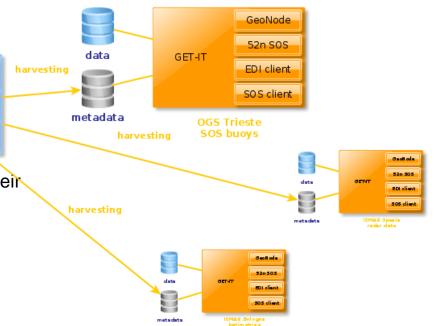
- Geothermy monitoring
 - o Groundwater influence in geothermy platforms

GET-IT: GeoEnabling Information Toolkit

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

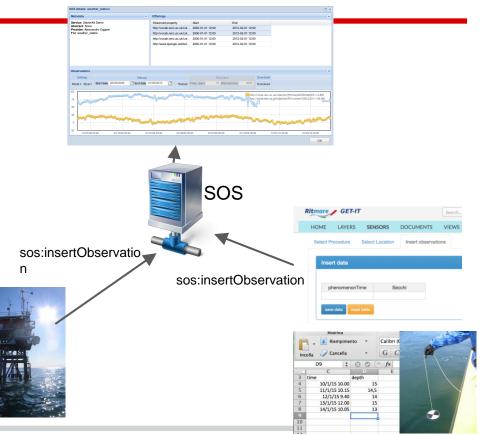


The main goal is to enable **non expert groups** to serve **geospatial** and **observational** data (plus their metadata) in an interoperable way through **autonomous nodes** in the infrastructure for the collection, annotation, and deployment of data



GET-IT: GeoEnabling Information Toolkit

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



SOS Client Interface

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SOS Client Interface

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	<u>~</u>	Offerings					
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- . 52°N
- . Austrian AIT
- . Geomatys
- . IST-SOS
- . Kisters
- . + several ad-hoc solutions

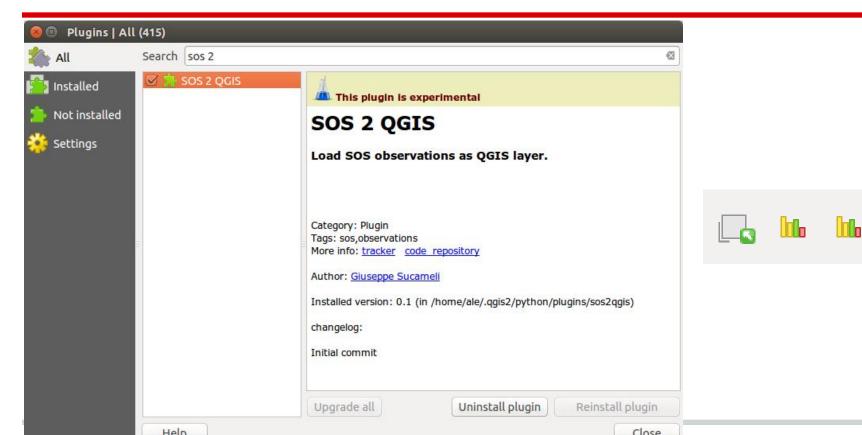
Client

- . 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

🔊 🗊 🛛 Rit Mare Service URL http://mareesk.irea.cnr.it/observations/sos ▼ > Service Info Filter Title StarterKit del Centro Previsioni Segnalazioni Maree Questo strumento ha come scopo di rendere disponibili le osservazioni provenienti dalle stazioni della rete mareografica del Centro Previsioni Segnalazioni Maree attraverso l'uso di servizi web OGC di tipo Sensor Web (SWE) ed in particolare Sensor Observation Service (SOS). This tool aims to make Abstract available the observations received from the network stations of the Tidal Prediction Center (Centro Previsioni Segnalazioni Maree) through the use of web services OGC Sensor Web type (SWE) and, in particular, Sensor Observation Service (SOS). Features of interest http://sp7.irea.cnr.it/featureOfInterest/PuntaSaluteCanalGrande http://sp7.irea.cnr.it/featureOfInterest/Misericordia http://sp7.irea.cnr.it/featureOfInterest/ChioggiaPorto http://sp7.irea.cnr.it/featureOfInterest/DigaSudChioggia http://sp7.irea.cnr.it/featureOfInterest/PalazzoCavalli http://sp7.irea.cnr.it/featureOfInterest/PuntaSaluteCanaleGiudecca http://sp7.irea.cnr.it/featureOfInterest/MalamoccoPorto Observed properties http://vocab.nerc.ac.uk/collection/P01/current/CDTBZZ01/ http://vocab.nerc.ac.uk/collection/P01/current/CPRPRG01/ http://vocab.nerc.ac.uk/collection/P01/current/CRELZZ01/ http://vocab.nerc.ac.uk/collection/P01/current/EGTSSS01/ http://vocab.nerc.ac.uk/collection/P01/current/ERWDSS01/ http://vocab.nerc.ac.uk/collection/P01/current/ERWSZZ01/ http://vocab.nerc.ac.uk/collection/P02/current/ASLV/ http://vocab.nerc.ac.uk/collection/P02/current/CAPH/ Close OK

Select Properties and create Spatialite DB

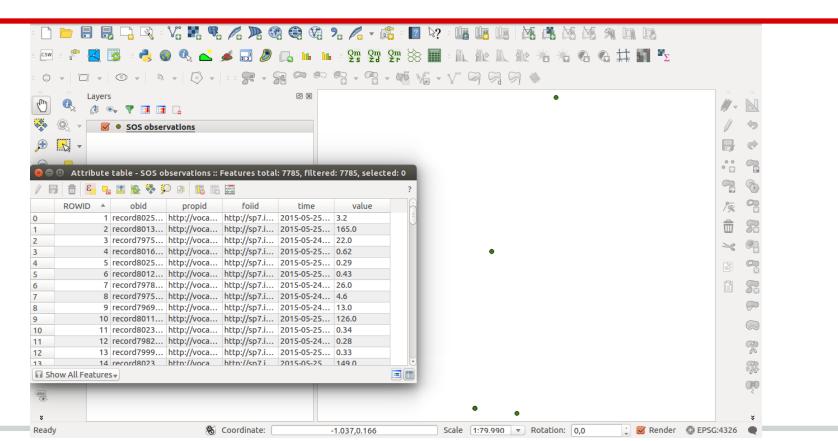
😣 💷 RitMare
Service URL http://mareesk.irea.cnr.it/observations/sos
Service Info Filter
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Temporal
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Properties
Absolute temperature of the atmosphere
Thickness of precipitation amount (liquid water equivalent) in the atmosphere by
Relative humidity of the atmosphere
 Wind speed (gust) in the atmosphere by in-situ anemometer Wind direction (relative to moving platform) in the atmosphere by in-situ anemo
Wind speed (relative to moving platform) in the atmosphere
Sea level
Air pressure
Temperature of the water column
http://www.opengis.net/def/property/OGC/0/PhenomenonTime

RitMare

Getting observations [request 1/3]...



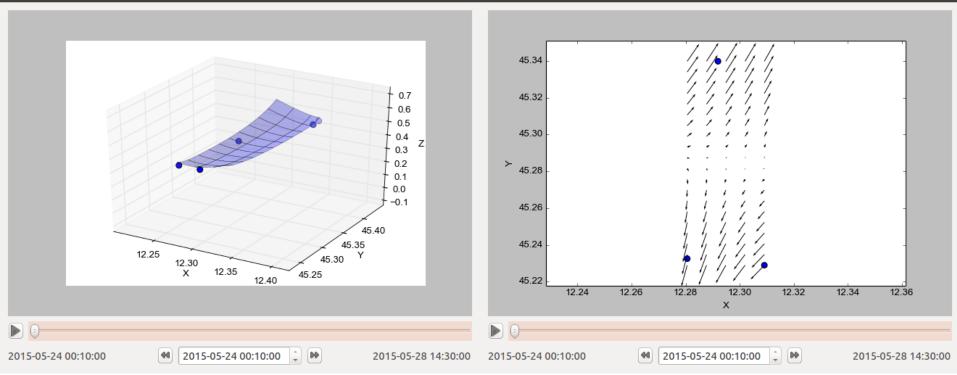
Visualize FOIs and values



Static and dynamic graphics

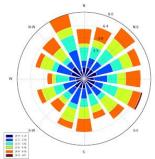
😣 🗐 🗊 🛛 Water level

😣 亘 🗉 Wind speed and direction



To do

- 2D xy graph with multiple properties, multiple FOIs
- Other types of data: e.g. windrose
- What are your requirements?
 - Domain (property) specific
 - \circ Use case specific



Providing INSPIRE measurement data

Thanks for your attention!





brqm





TOMORROW TODAY