

# Water Quality Interoperability Experiment

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WMO Capacity Building Workshop on Hydrological Data Exchange, Standardization, Interoperability

# Open Geospatial Consortium (OGC) ?



## What is OGC?

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A hub for thought leadership, innovation, and standards for all things related to location

### Our Vision

Building the future of location with community and technology for the good of society

### Our Mission

Make location information Findable, Accessible, Interoperable, and Reusable (FAIR)

### Our Approach

A proven collaborative and agile process combining consensus-based standards, innovation project, and partnership building



# Open Geospatial Consortium (OGC) ?



## Who Are Our Members?

### Commercial

Business Development

Competitive Technical Advantage

Global: Brand Exposure

Funding for Innovation

### Government

Innovation & Market Support

Trusted Advice

Support & Certification

International Partnerships

Operational Policy

### Research & Academia

Applied Research Partners

Funding for Innovation

International Collaboration

Citations

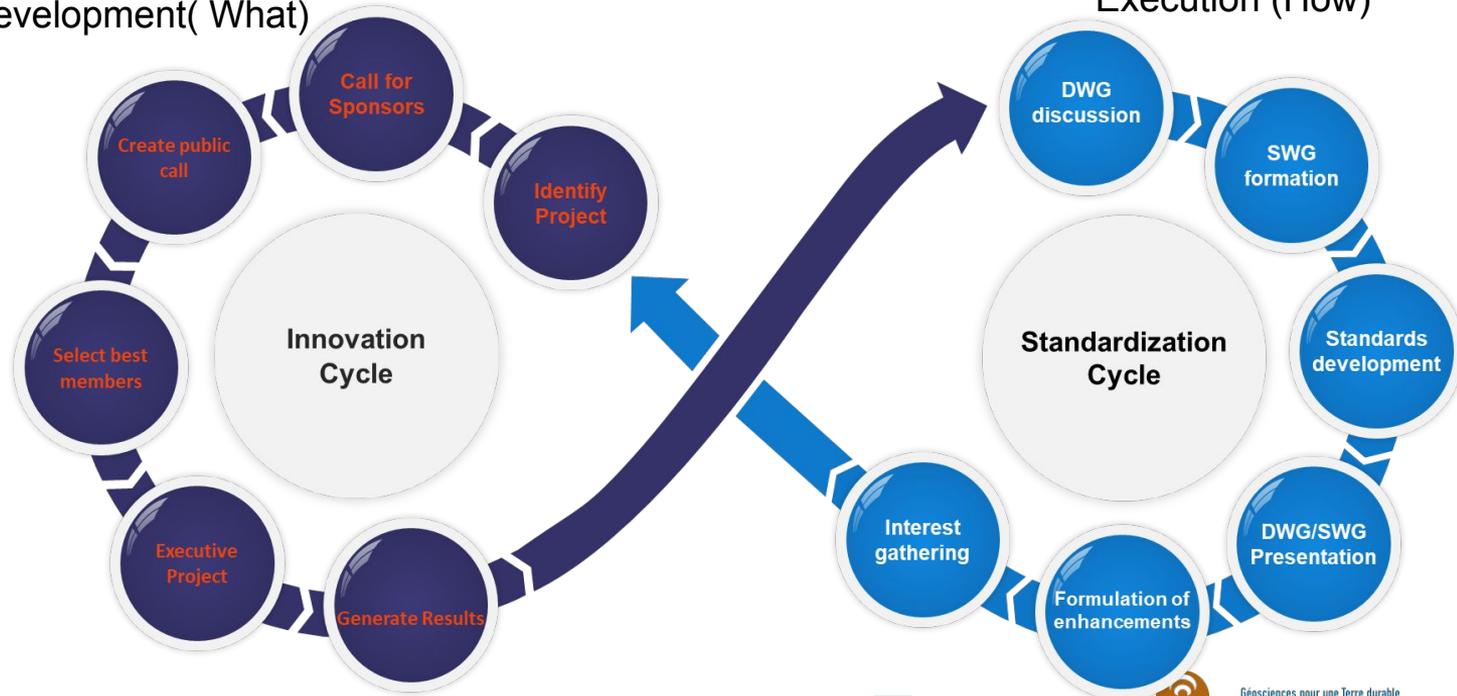


# OGC Interoperability Experiment (IE) ?

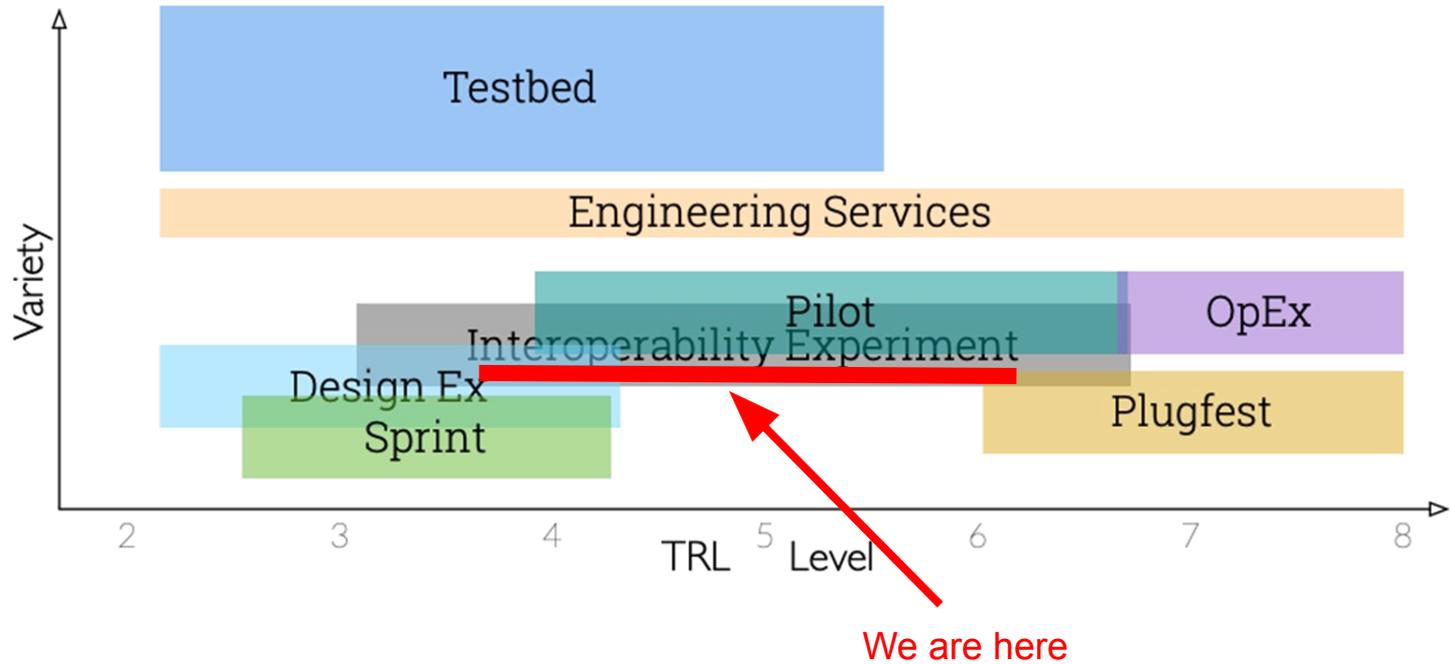
- OGC Innovation Continuum

Innovation Roadmap  
Development( What)

Innovation Roadmap  
Execution (How)



# OGC Interoperability Experiment (IE) ?



# OGC Interoperability Experiment (IE) ?

- Applied research initiative led by OGC members and supported by OGC staff
  - => Most of the time building on the current standards and best practices : the 'OGC Baseline' (pushing them to their limits / applying them to a new domain)
- Non-OGC member participation is allowed (usually as observers)
  - => In several IEs: GitHub + mailing list + meetings are open
  - => so the 'observers' can be really active
- Results documented in Engineering Report(s) or other OGC documents and generally used to define new Standardization work.
  - => Some lead to Change Request to the 'OGC Baseline'
  - => Some to Best Practices in applying it
  - => Some fill in gaps in the 'OGC Baseline' proposing document ready for the standardization process: exactly what happened to all the WaterML2.0 series of standards
  - => Most important : it's during the IE that the group decides what the output of the IE will be : through experimentation



# OGC Water Quality IE set up

- Third time the topic is proposed within the OGC Hydro Domain Working Group
- Enough momentum and interest from parties (including international organisations such as WMO, UNEP, WHO, UNESCO) reached

=> WMO-UNEP-WHO-UNESCO Water Quality workshop in March 2022 (29-31)

[https://external.ogc.org/twiki\\_public/HydrologyDWG/WaterQualityWorkshopSprint2022](https://external.ogc.org/twiki_public/HydrologyDWG/WaterQualityWorkshopSprint2022)

=> confirmation of the necessity and organizations interest. Identification of interested parties and IT challenges  
Discussion on the best approach => an OGC Interoperability Experiment

- Water Quality IE inception

=> Charter, call for participation, kick-off- (20/09/2022)

Since then :

- Starting point : <https://github.com/opengeospatial/WaterQualityIE>
- Weekly meetings
- Shared material
  - Rolling meeting minutes document,
  - One focal point for UML models
  - Shared deployment documentation initiated
- Note : shared images in that presentation represent **Work In Progress** currently being tested  
the Engineering Report will summarize the group conclusion



# Use Cases identification and work methodology

	Org	Fol Type: Water (Surface and Ground together at this stage)			
Method	<i>Observed Property group</i>	Quantity	Physical properties	Chemistry	Biology
	Samples	Here as a support to WQ	1	2	3
	Sensors				
	Hydro Models				
	Remote Sensing				

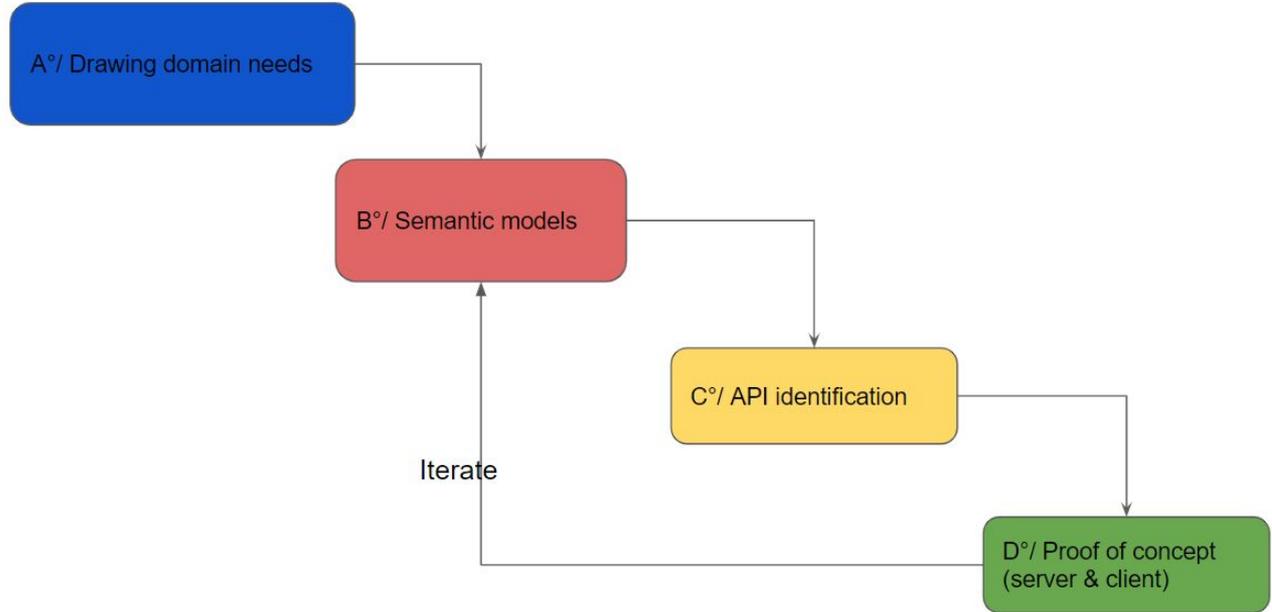
*Fol = Feature Of Interest = the real world phenomenon on which observation is made*

- Water Quality Use Case prioritisation
  - Physical Properties (ex : Température, Conductivity), Chemistry
  - + Water Quantity as a support to Water Quality
  - *Out of scope this IE : Biology (taxa observation), Hydro Models, Remote Sensing*



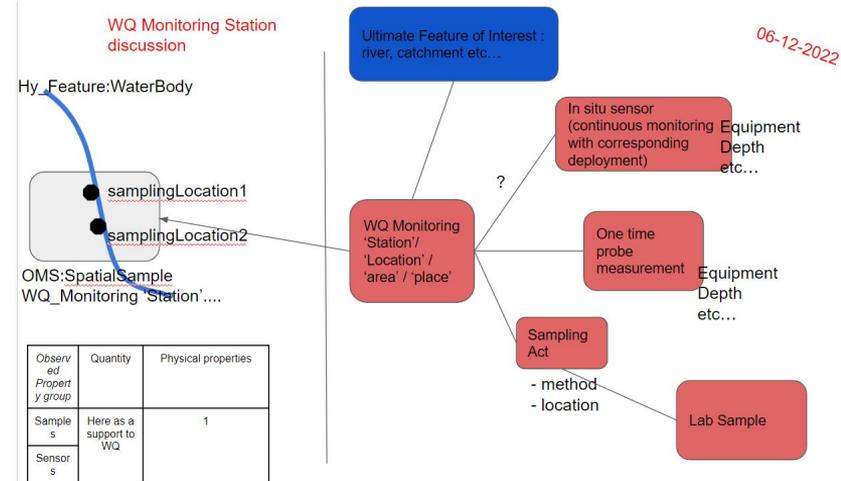
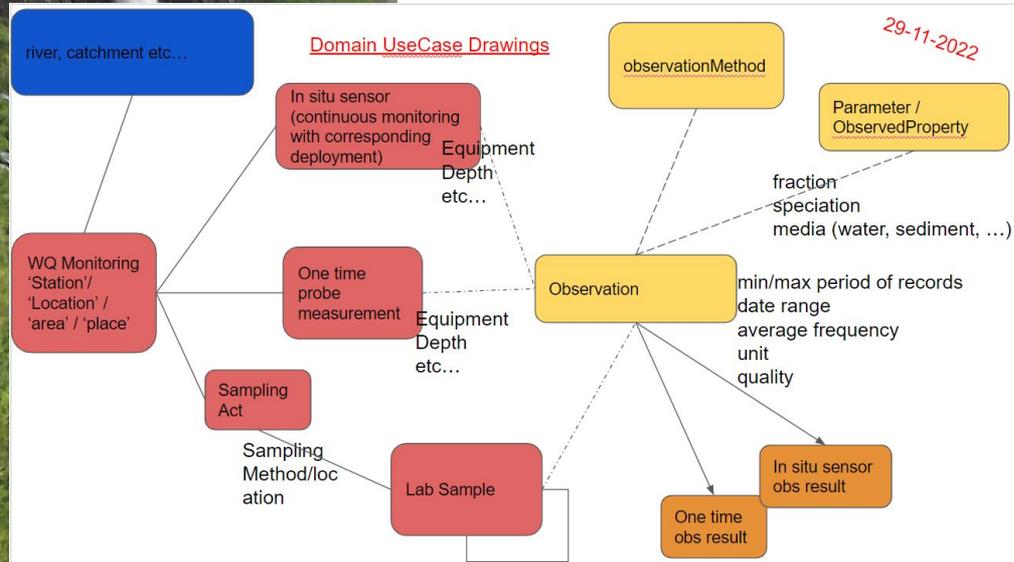
# Use Cases identification and work methodology

## Rationale (per Use Case)



# Conceptual Modelling

- Step 1°/ Express the domain need stemming from the UseCases



# Conceptual Modelling

- Step 2°/ Identify the standards in the OGC standard baseline to build on
  - 2 OGC-WMO water standards : GroundWaterML2.0 & HY\_Features
  - THE OGC-ISO for Observations & Samples : ISO 19156:2023 : Observations, measurements and samples

OGC® DOCUMENT: 16-032R3  
External identifier of this OGC® document: <http://www.opengeis.net/doc/IS/GWML/2.2.1>

OGC®  
Making location count.

## OGC WATERML 2: PART 4 - GROUNDWATERML 2 (GWML2)

STANDARD Implementation  
APPROVED

Version: 2.2.1  
Submission Date: 2019-04-15  
Approval Date: 2019-09-15  
Publication Date: 2021-01-20  
Editor: Sylvain Brodeur

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## OGC® WaterML 2: Part 3 - Surface Hydrology Features (HY\_Features) - Conceptual Model

### Open Geospatial Consortium

Submission Date: 2017-08-17

Approval Date: 2017-10-16

Publication Date: 2018-01-68

External identifier of this OGC® document: <http://www.opengeis.net/doc/SHv-features/1.0>

Internal reference number of this OGC® document: 14-11116

Version: 1.0

Category: OGC® Implementation Standard

Editor: David Blodgett, Irina Dornbust

### OGC® WaterML 2: Part 3 - Surface Hydrology Features (HY\_Features) - Conceptual Model

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Document type:	OGC® Standard
Document subtype:	
Document stage:	Approved
Document language:	English

### Open Geospatial Consortium

Submission Date: 2021-11-18

Approval Date: 2022-03-07

Publication Date: 2023-05-26

External identifier of this OGC® document: <http://www.opengeis.net/doc/asom/3.0>

Internal reference number of this OGC® document: 20-082r4

Version: 3.0.0

Category: OGC® Abstract Specification

Editors: Katharina Schleidt, Ilkka Rinne

### OGC Abstract Specification Topic 20: Observations, measurements and samples

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Document stage:	Approved for public release
Document language:	English

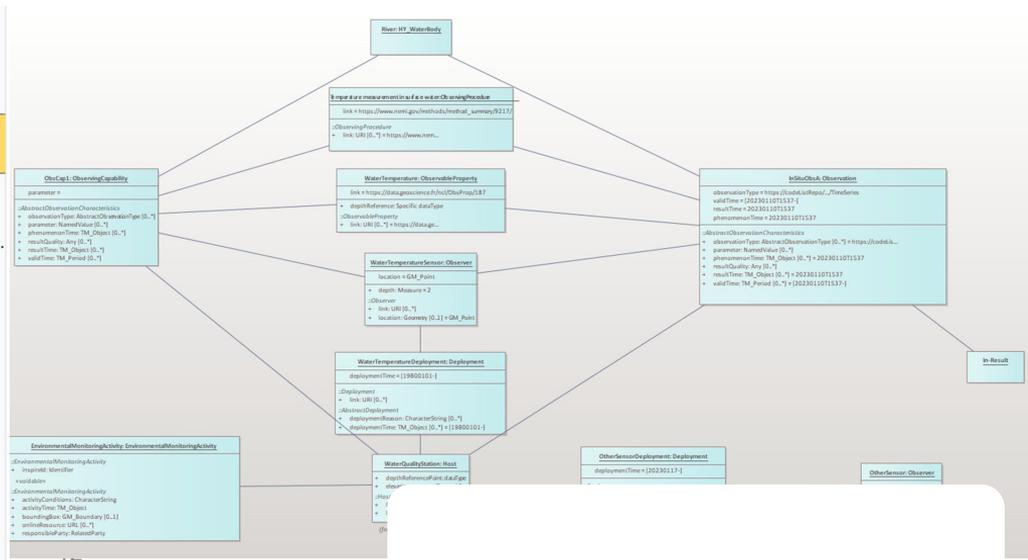
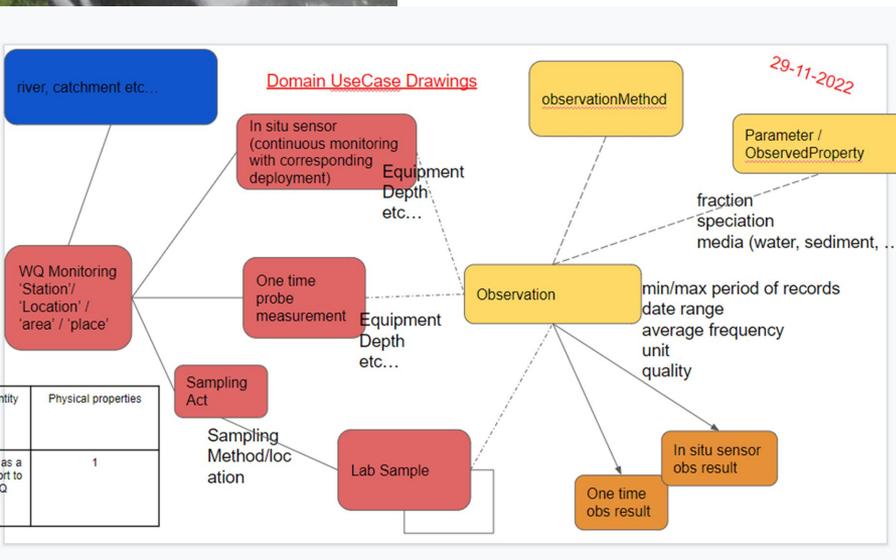


# Conceptual Modelling

- Step 3°/ Express domain needs according to the OGC standard baseline  
 => **Almost everything is in, just need to agree on how to use it**  
 => mainly “Object diagrams exercise” to document the use of the standards

FROM

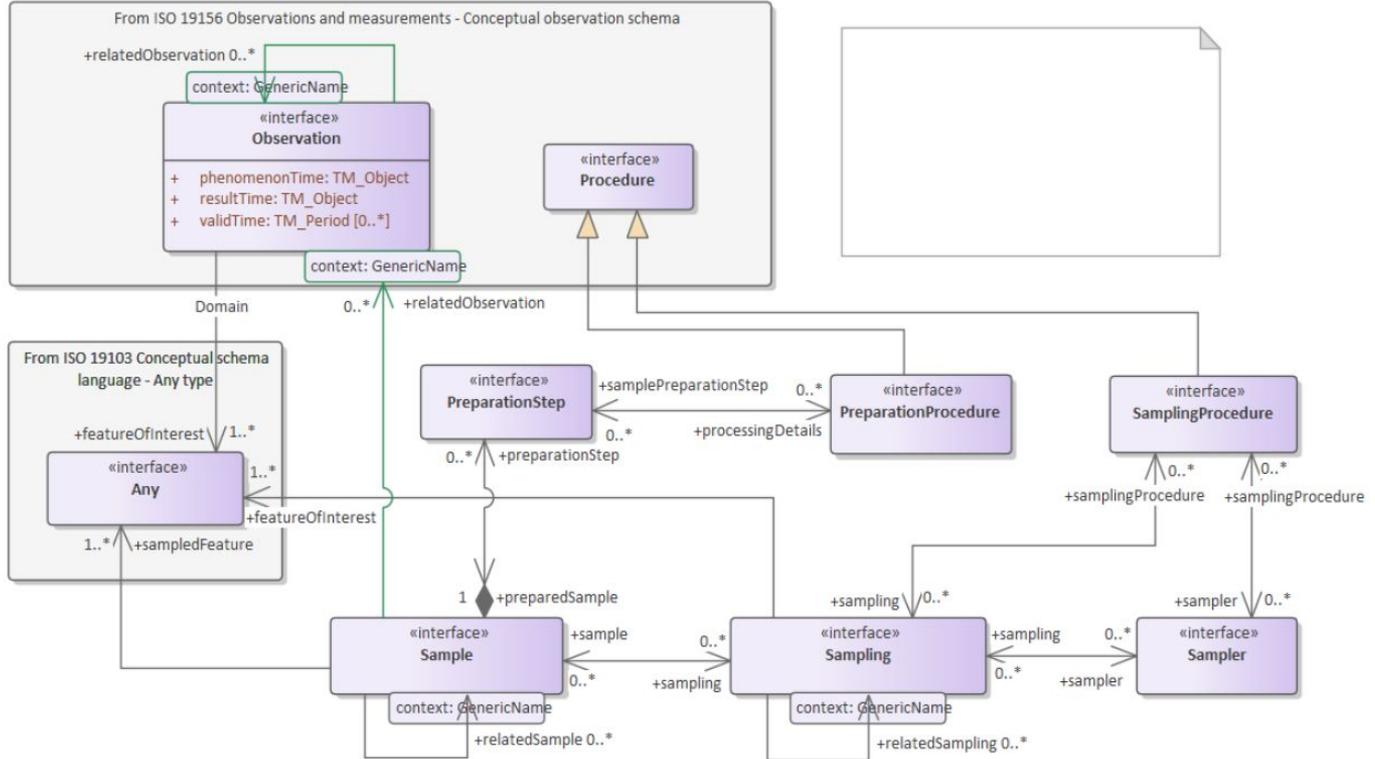
TO





# Conceptual Modelling

- Backbone to build on: Observations, measurements and samples



14  
Conceptual Sample schema



# Conceptual Modelling

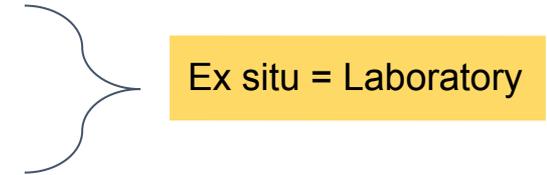
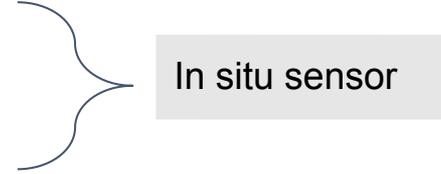
- Work organised around the identified UseCases
- Everything available online : <https://umltool.ogc.org/login.php>
  - Follow this path /OGC IEs/ WaterQuality\_IE/ WaterQuality\_Instance
- Ground Water (GW)
  - GW\_InSitu\_QuantityObservation
  - GW\_InSitu\_QualityObservation
  - GW\_ExSitu\_QualityObservation
- Surface Water (SW)
  - SW\_InSitu\_QuantityObservation
  - SW\_InSitu\_QualityObservation
  - SW\_ExSitu\_QualityObservation





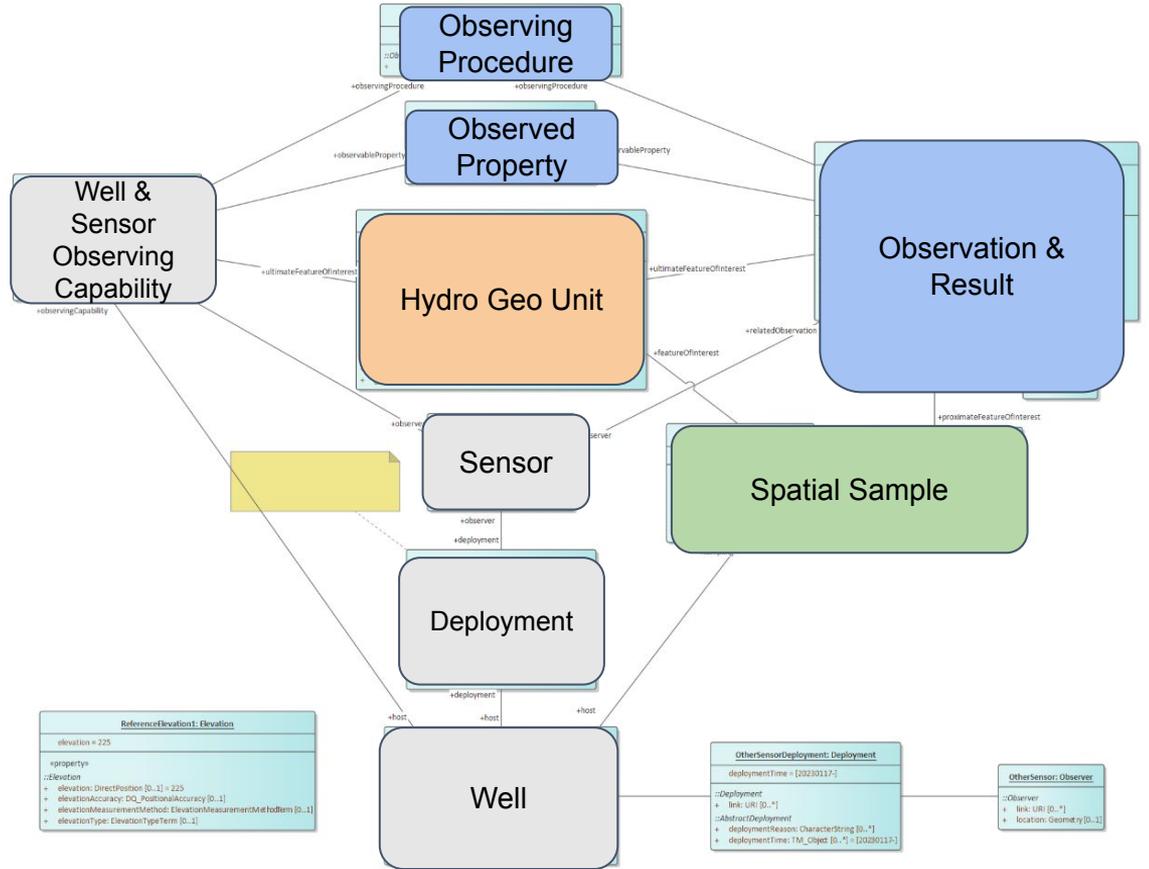
# Conceptual Modelling

- 2 modelling patterns
- GW\_InSitu\_QuantityObservation < > SW\_InSitu\_QuantityObservation  
GW\_InSitu\_QualityObservation < > SW\_InSitu\_QualityObservation
- GW\_ExSitu\_QualityObservation < > SW\_ExSitu\_QualityObservation



# Conceptual Modelling

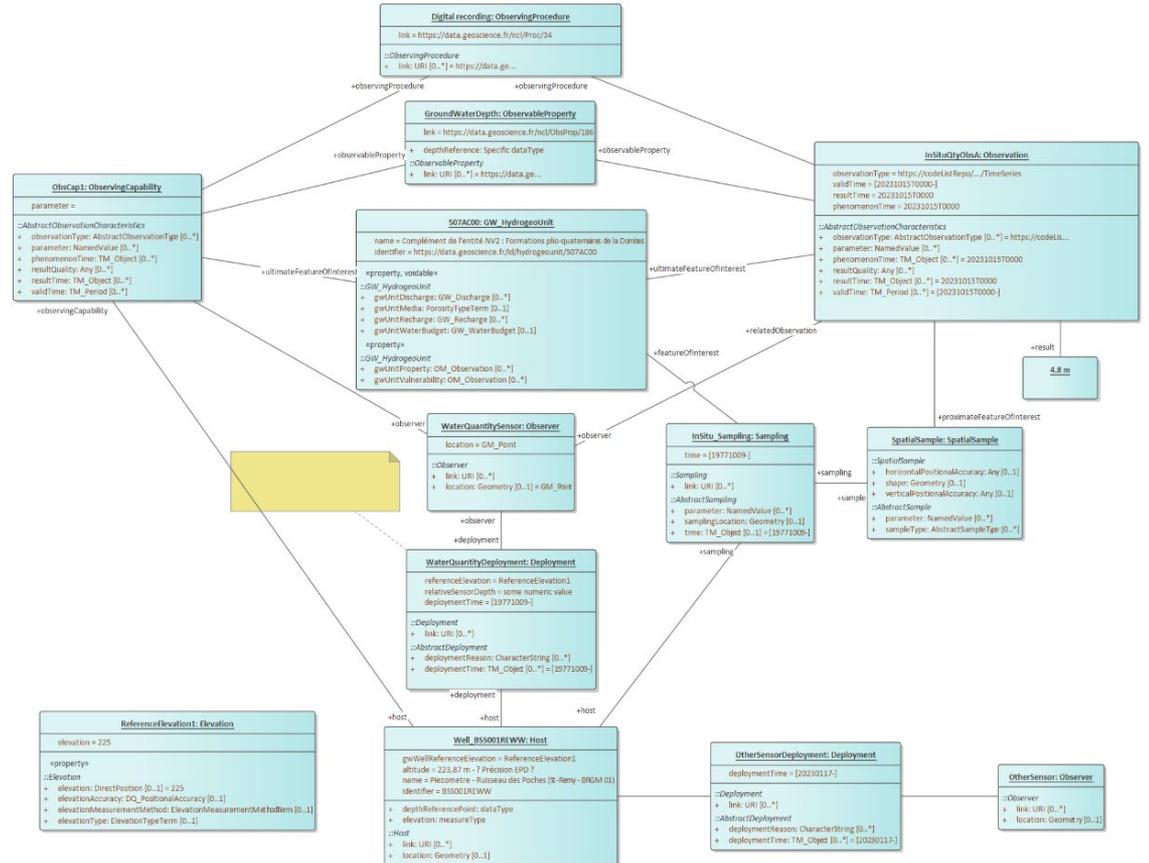
- **GW\_InSitu\_Quantity**Observation (water level)



In situ sensor

# Conceptual Modelling

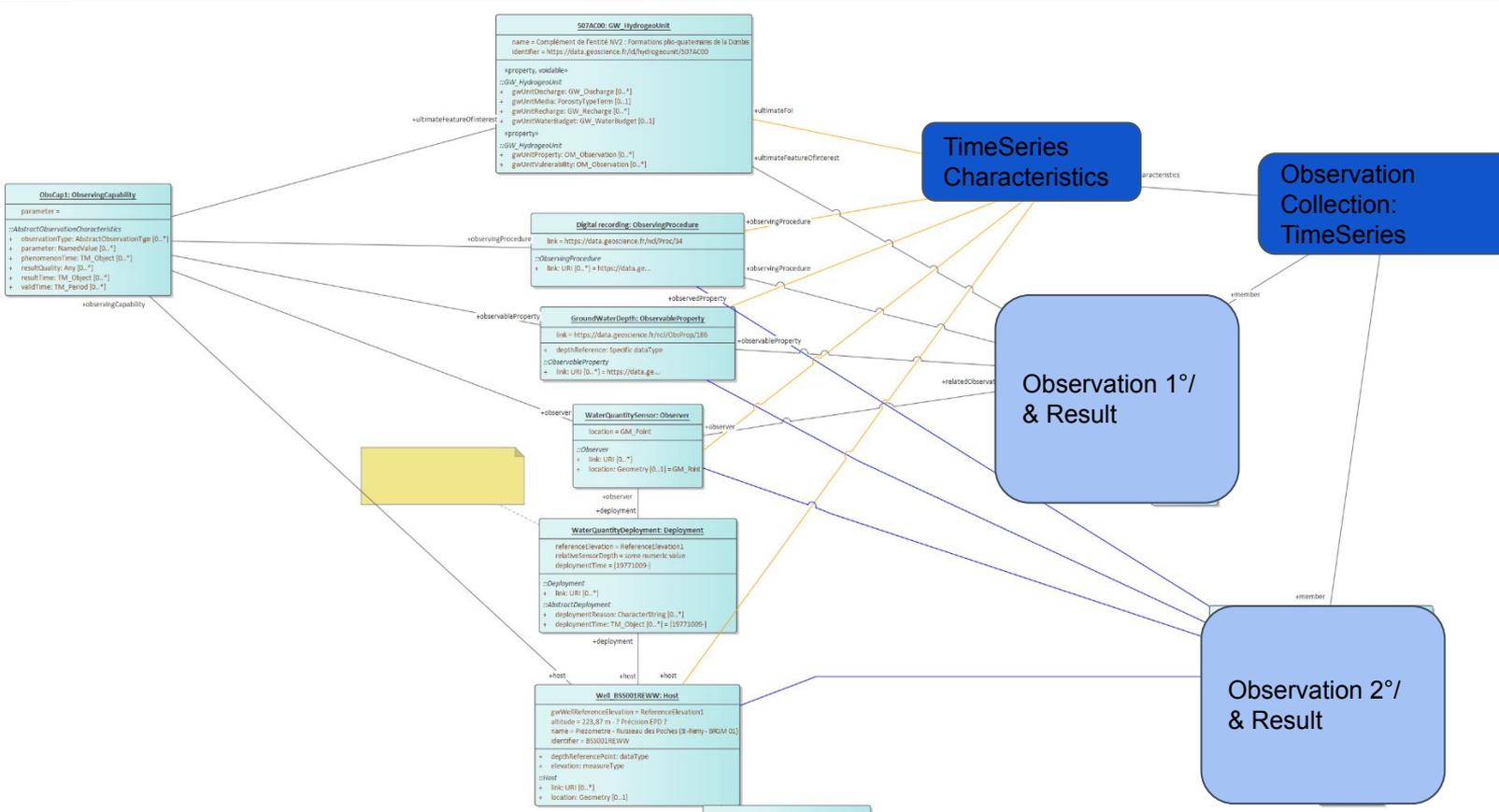
- GW\_InSitu\_QuantityObservation (water level)



In situ sensor

# Conceptual Modelling

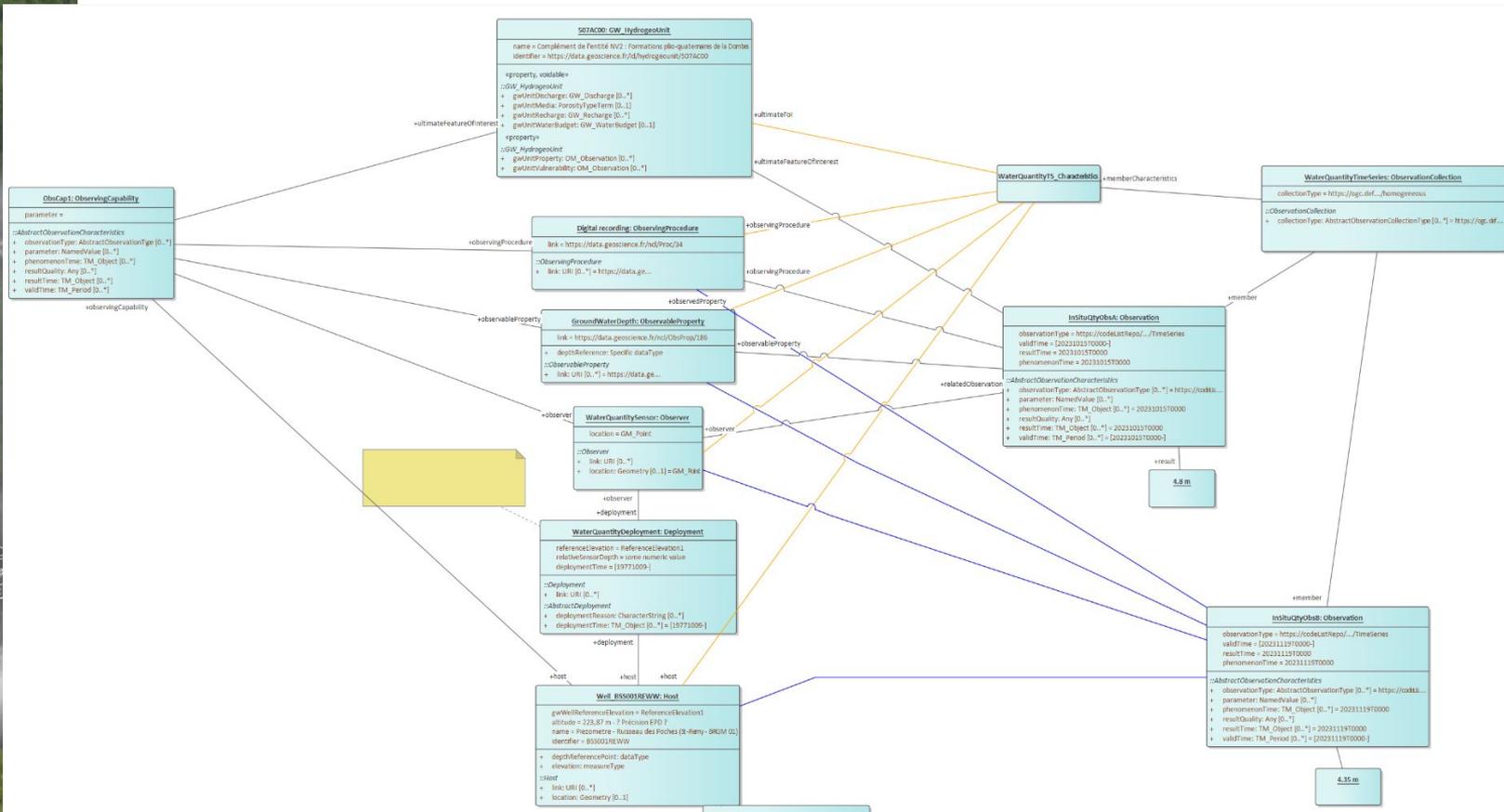
- **GW\_InSitu\_QuantityObservation (water level)**



# Conceptual Modelling

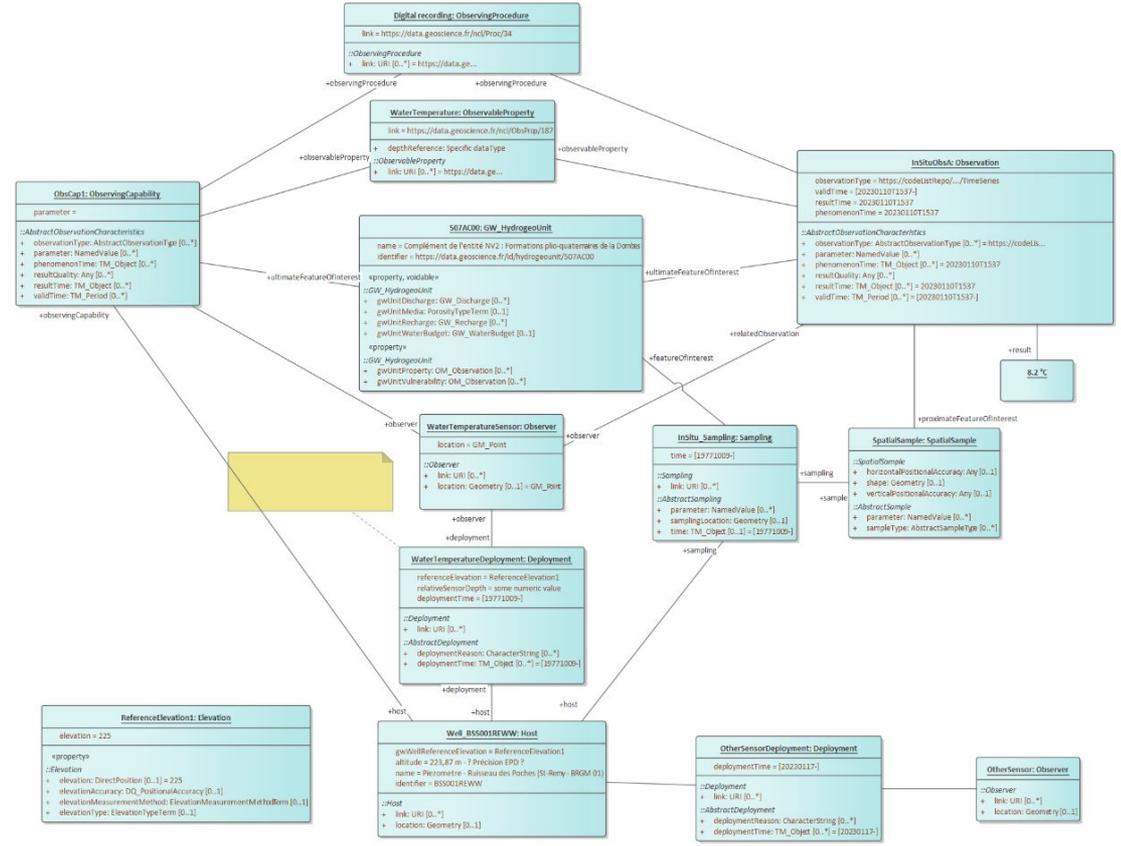
In situ sensor

- GW\_InSitu\_QuantityObservation (water level)



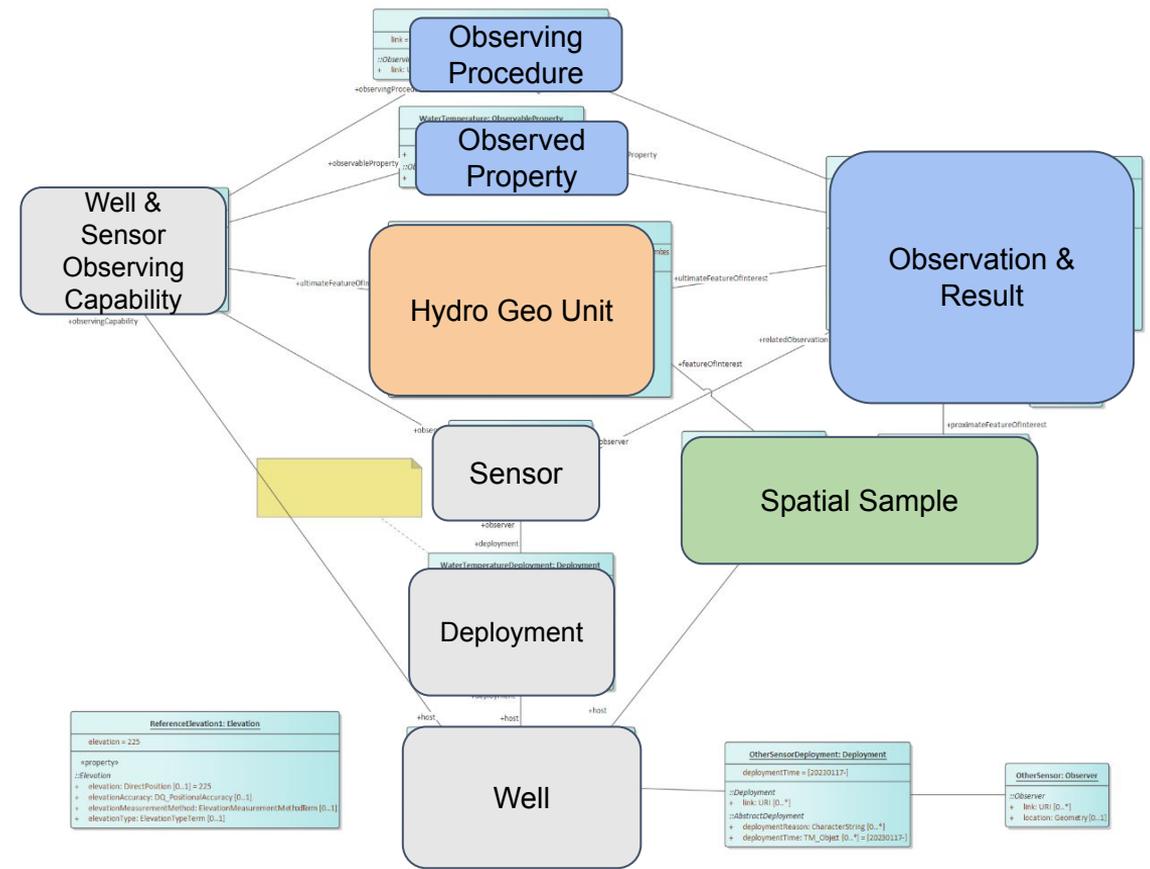
# Conceptual Modelling

- GW\_InSitu\_QualityObservation (temperature) => same pattern



# Conceptual Modelling

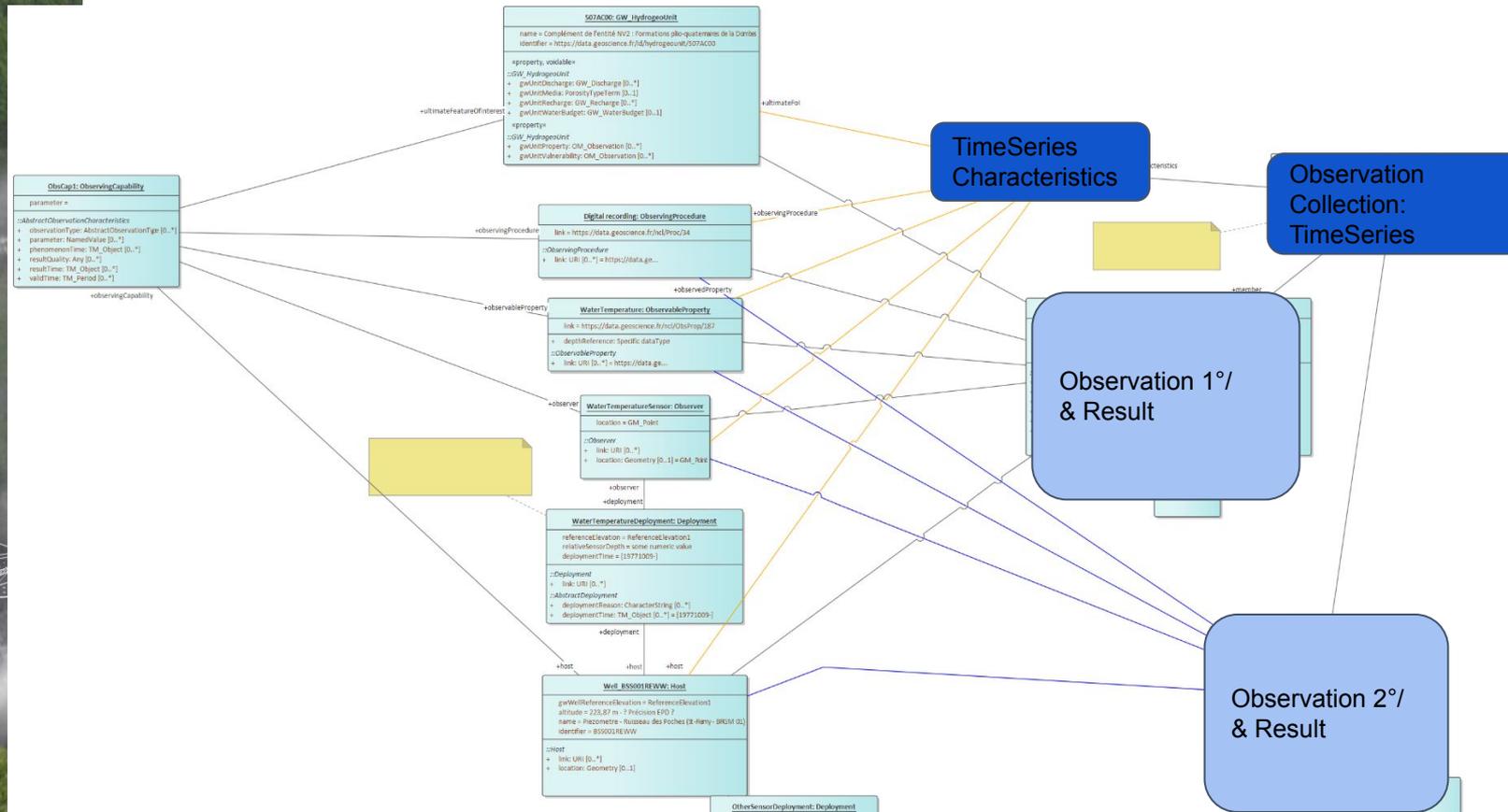
- GW\_InSitu\_QualityObservation (temperature) => same pattern



In situ sensor

# Conceptual Modelling

- **GW\_InSitu\_QualityObservation** (temperature) => same pattern

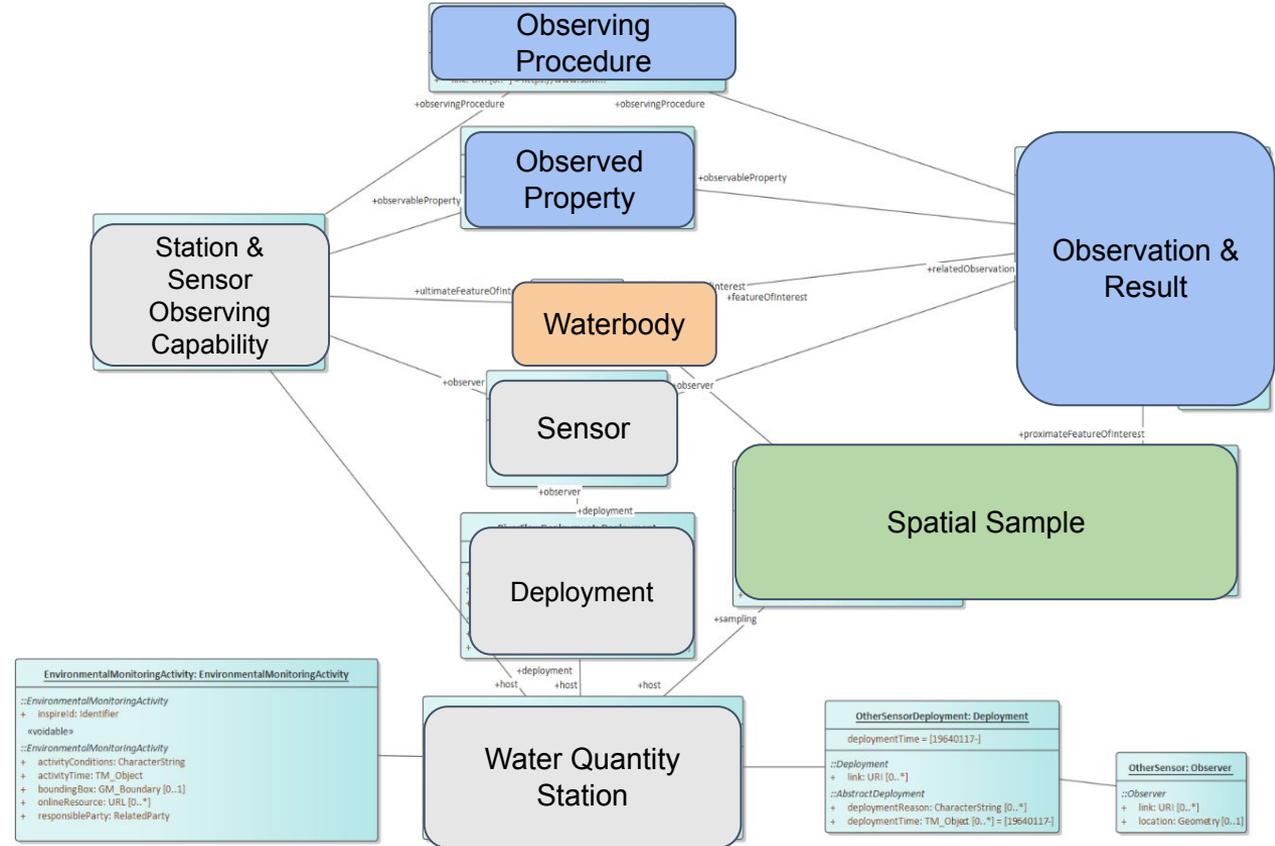




In situ sensor

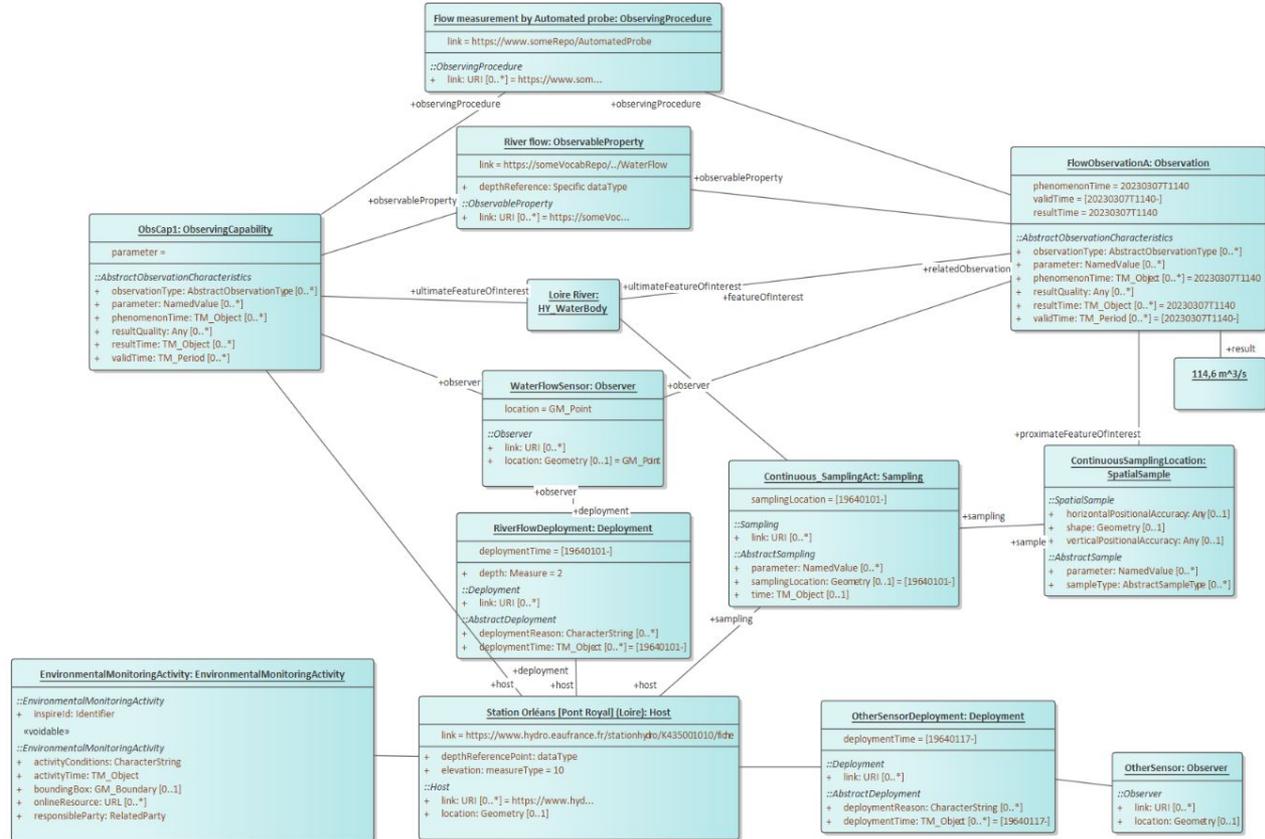
# Conceptual Modelling

- SW\_InSitu\_QuantityObservation (river flow) => same pattern



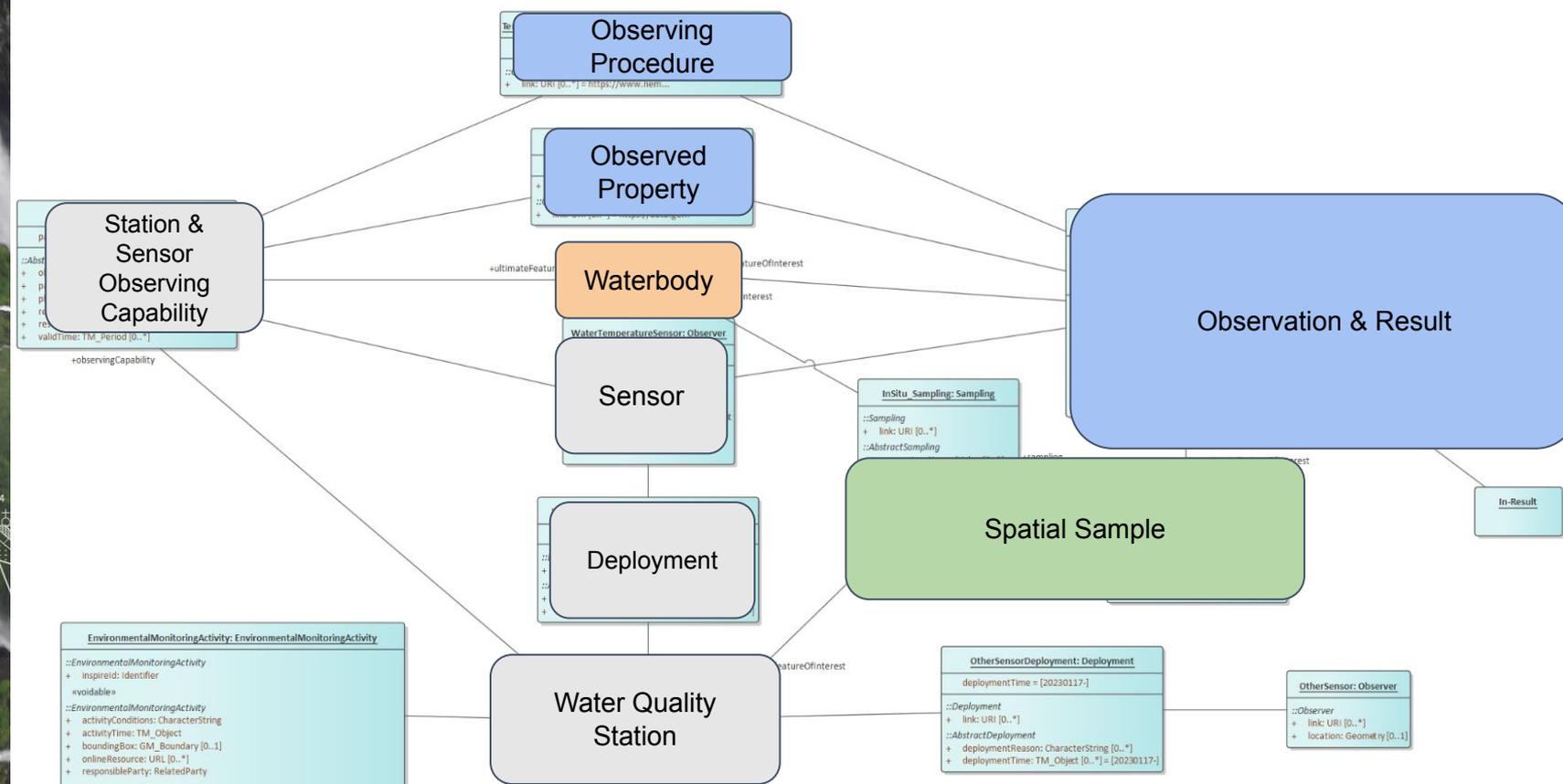
# Conceptual Modelling

- SW\_InSitu\_QuantityObservation (river flow) => same pattern



# Conceptual Modelling

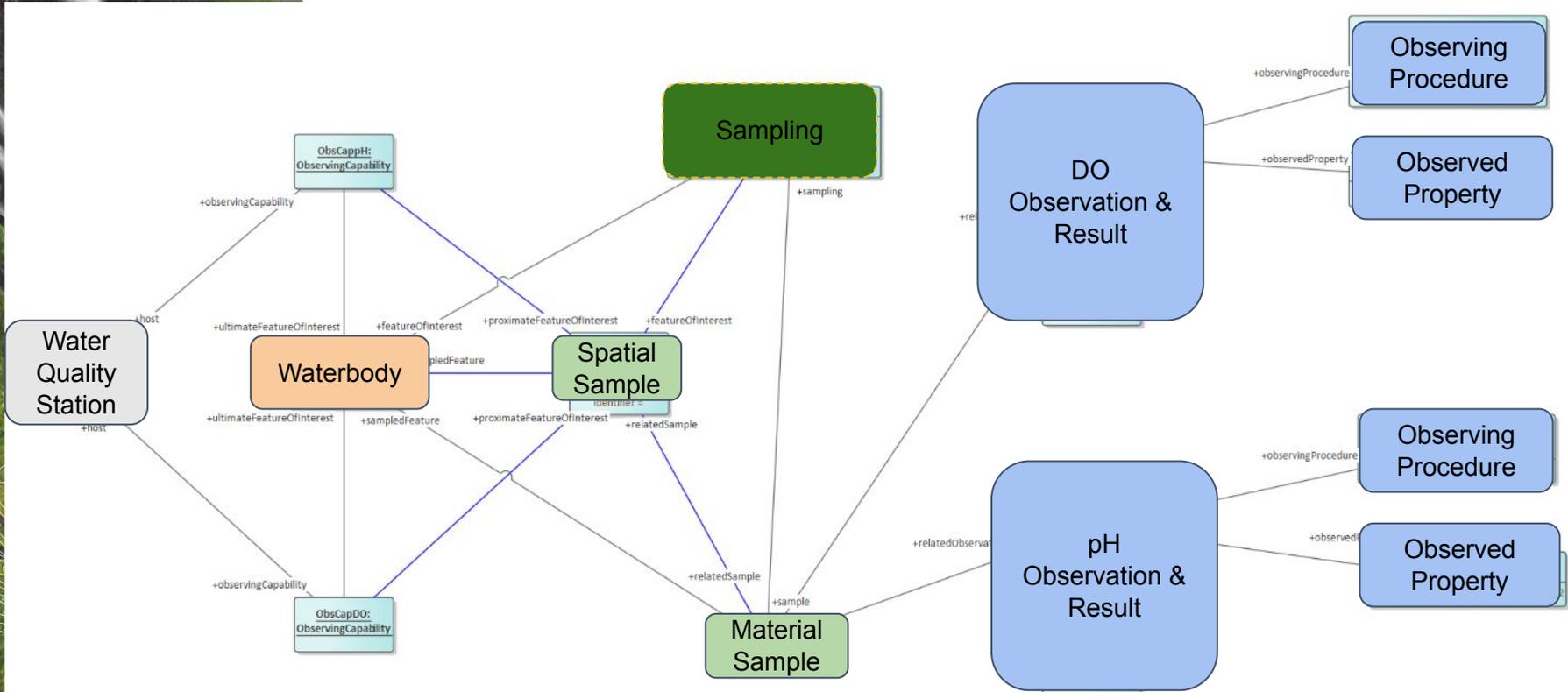
- SW\_InSitu\_QualityObservation (temperature, pH) => same pattern



# Conceptual Modelling

Ex situ = Lab

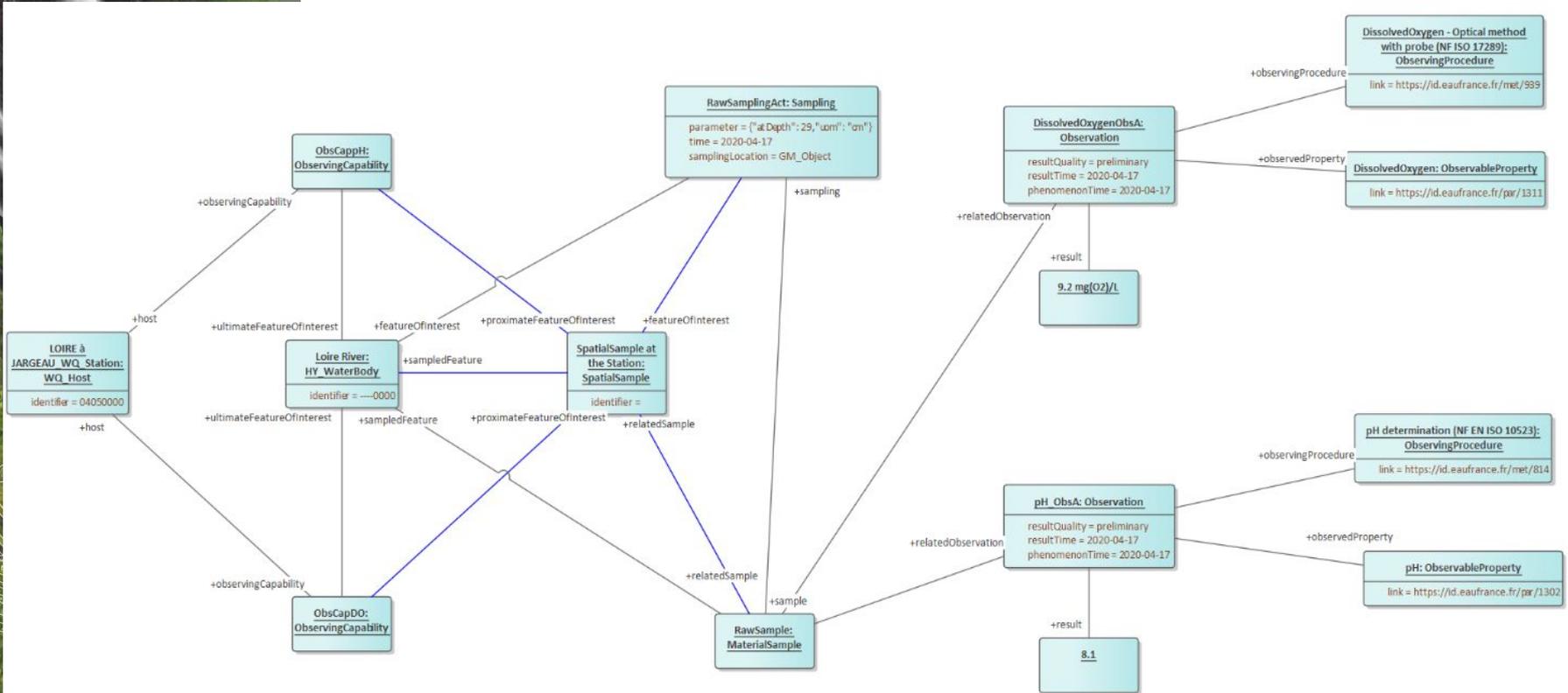
- SW\_ExSitu\_QualityObservation (ex : Dissolved Oxygen, pH)



# Conceptual Modelling

Ex situ = Lab

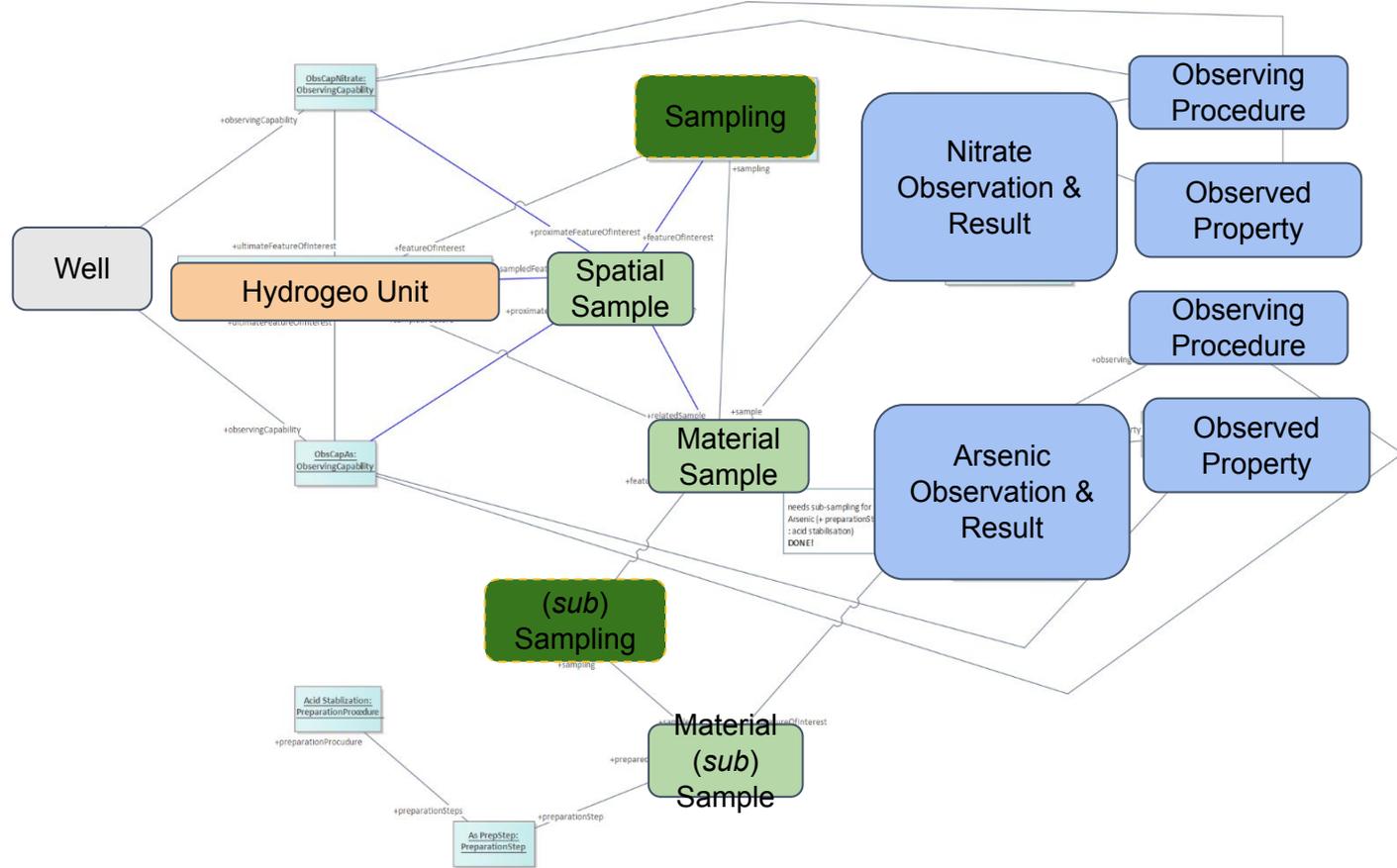
- SW\_ExSitu\_QualityObservation (ex : Dissolved Oxygen, pH)



# Conceptual Modelling

Ex situ = Lab

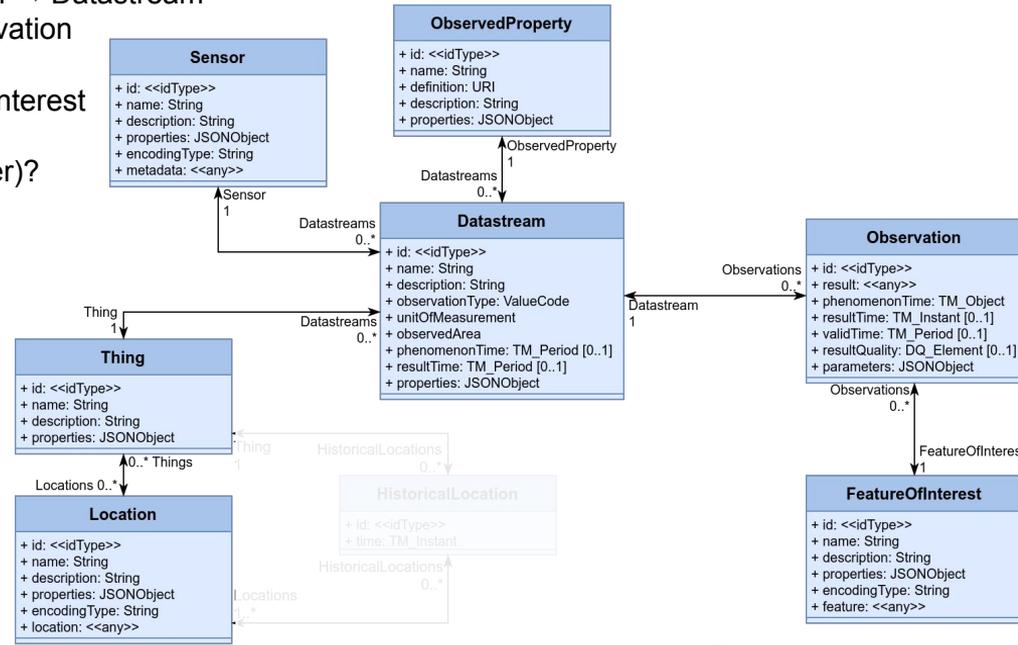
- GW\_ExSitu QualityObservation (ex : Nitrate, Arsenic) => same pattern





# Physical model -> Mapping to SensorThings API

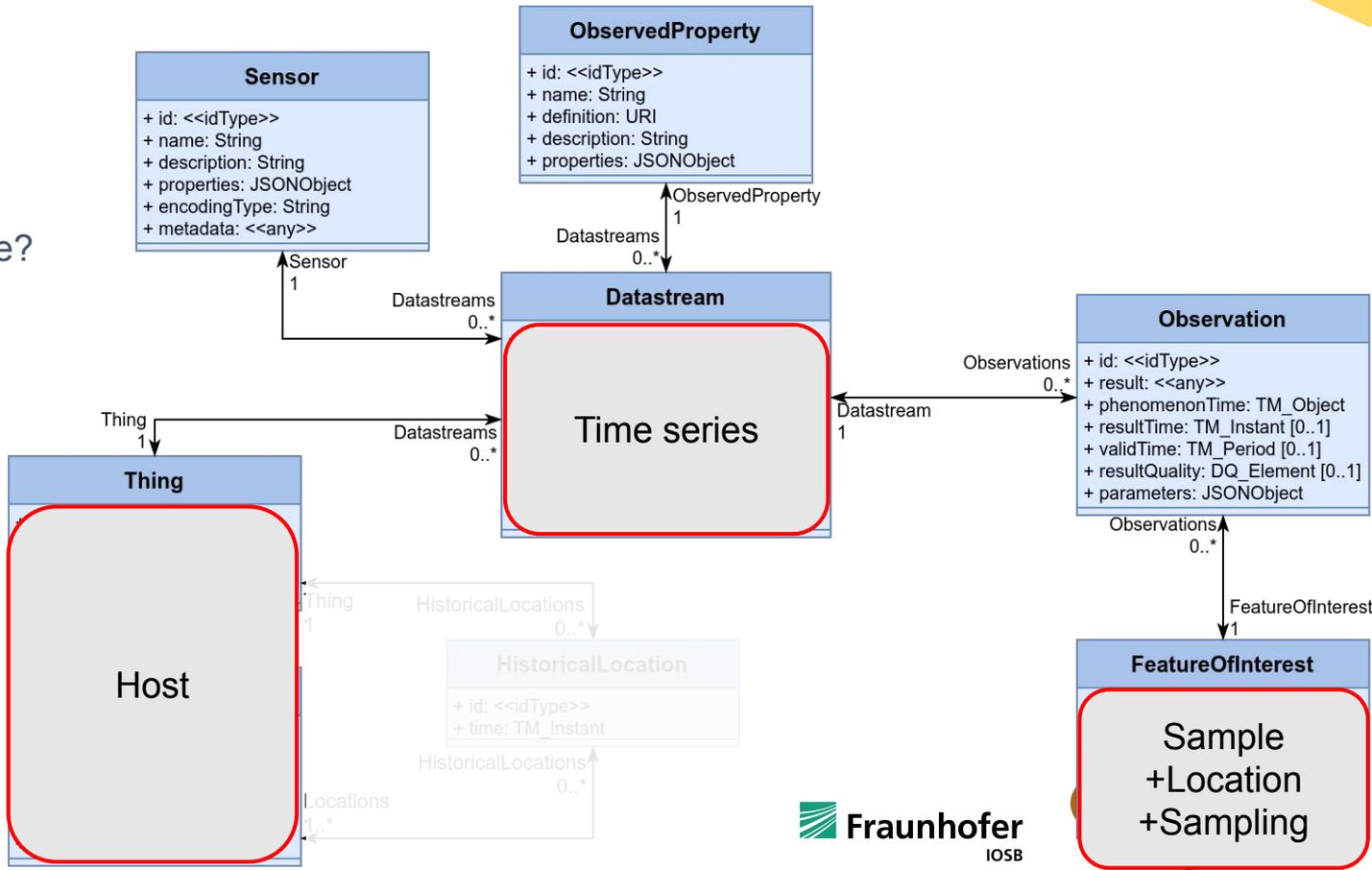
1. Map matching concepts
  - Monitoring Facility → Thing + Location
  - Observed Property → ObservedProperty
  - Observation Collection → Datastream
  - Observation → Observation
  - Observer → Sensor
  - Sample → FeatureOfInterest
2. Add missing Classes
  - SampledFeature (River)?
  - Deployment?
  - Sampler?
  - ObservingProcedure?



# SensorThings API 1.1 – Water Quality

Ex situ = Lab

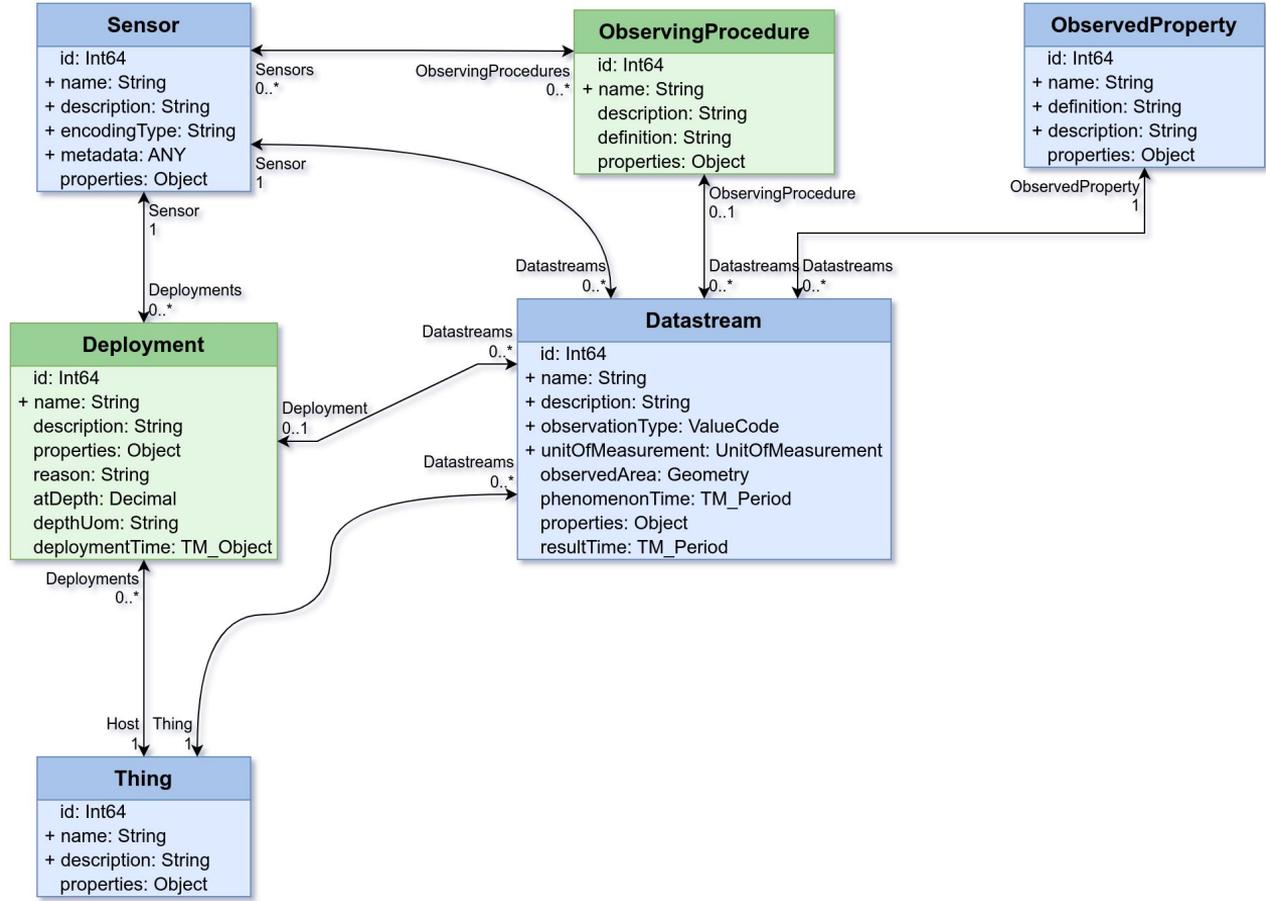
- River? (SampledFeature)
- Deployment?
- Sampler?
- ObservingProcedure?



# STA 1.1 WQ-IE – Sensor Extensions

## Extending the Sensor

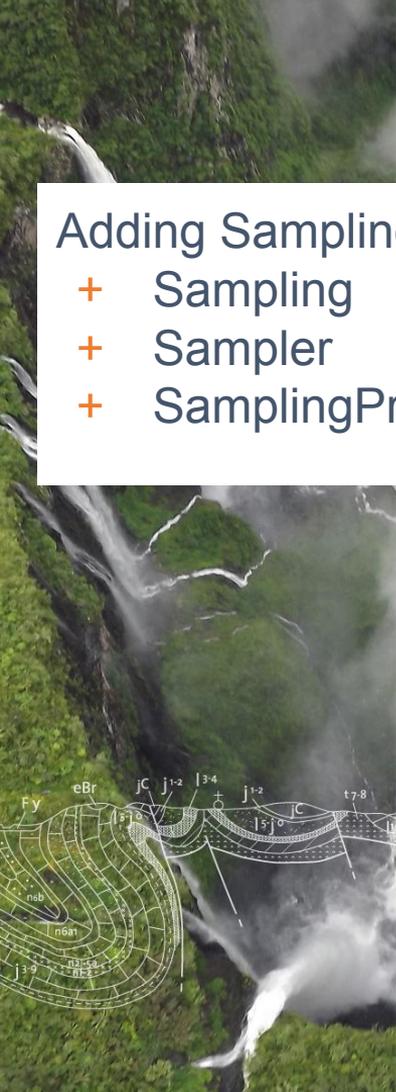
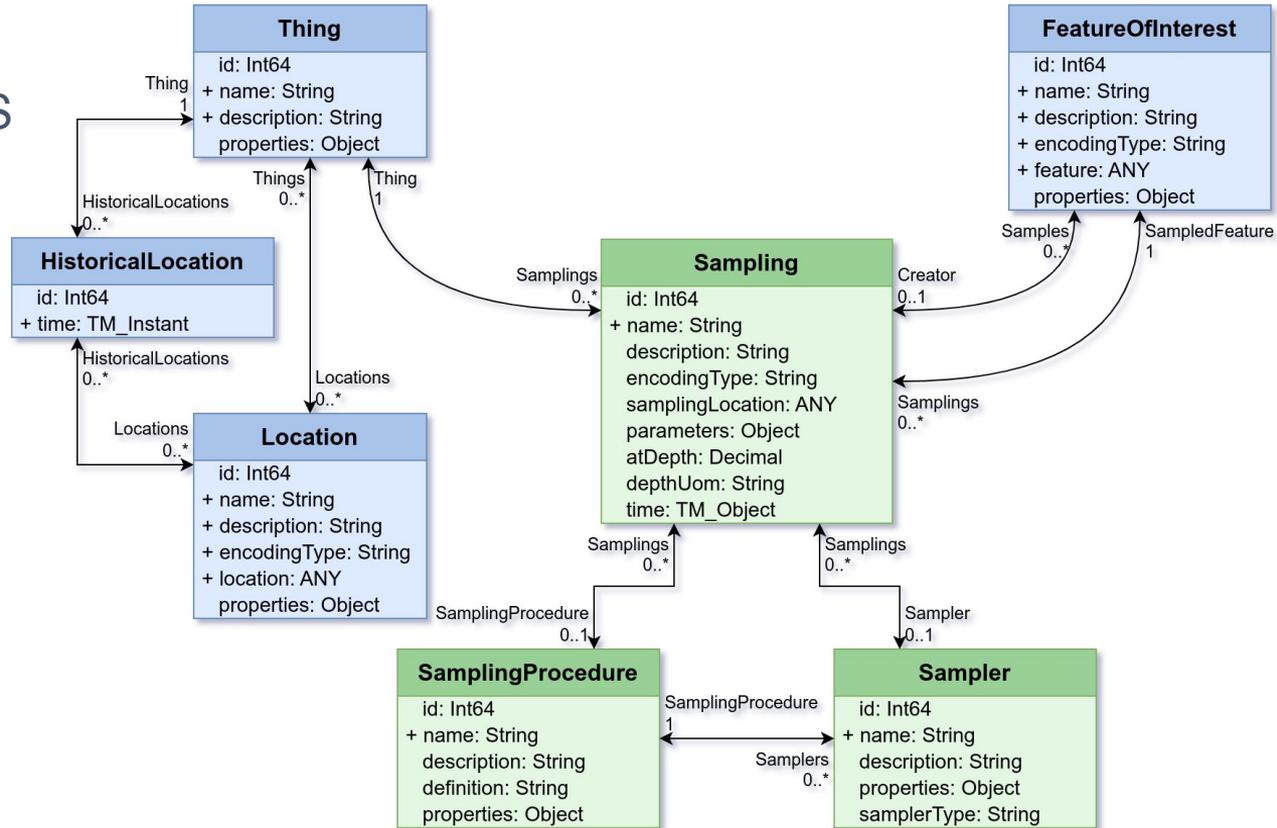
- + Deployment
- + ObservingProcedure



# STA 1.1 WQ-IE – Sampling

## Adding Sampling from OMS

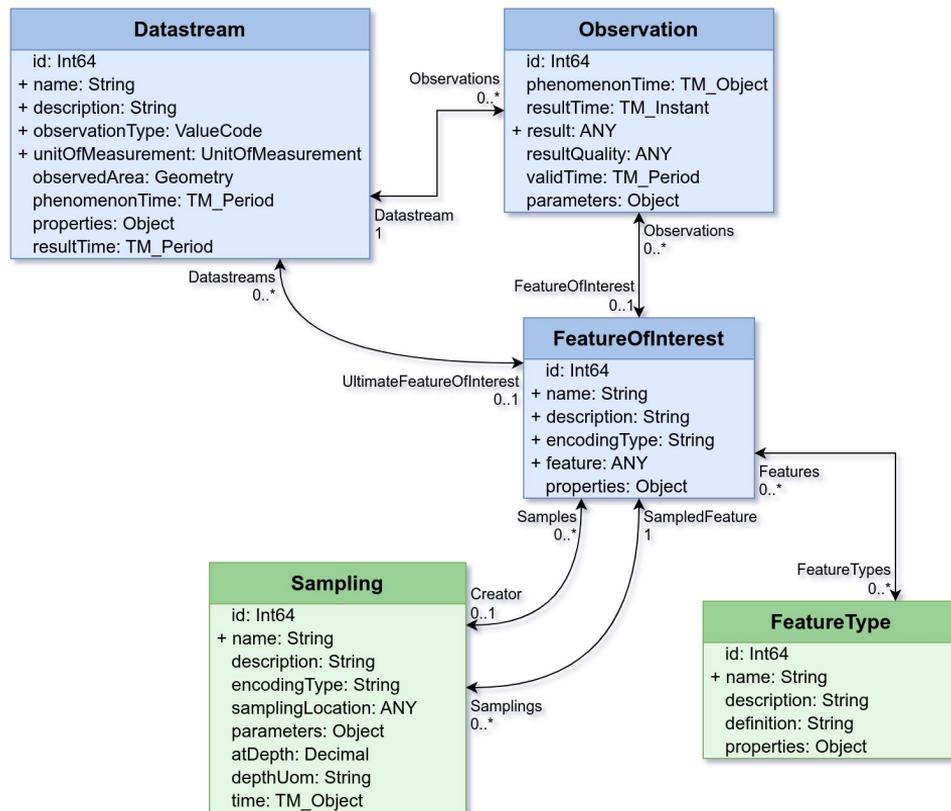
- + Sampling
- + Sampler
- + SamplingProcedure



# STA 1.1 WQ-IE – Features

Adding the River as Feature and linking a time series

- + FeatureType
- + Datastream → UltimateFeatureOfInterest



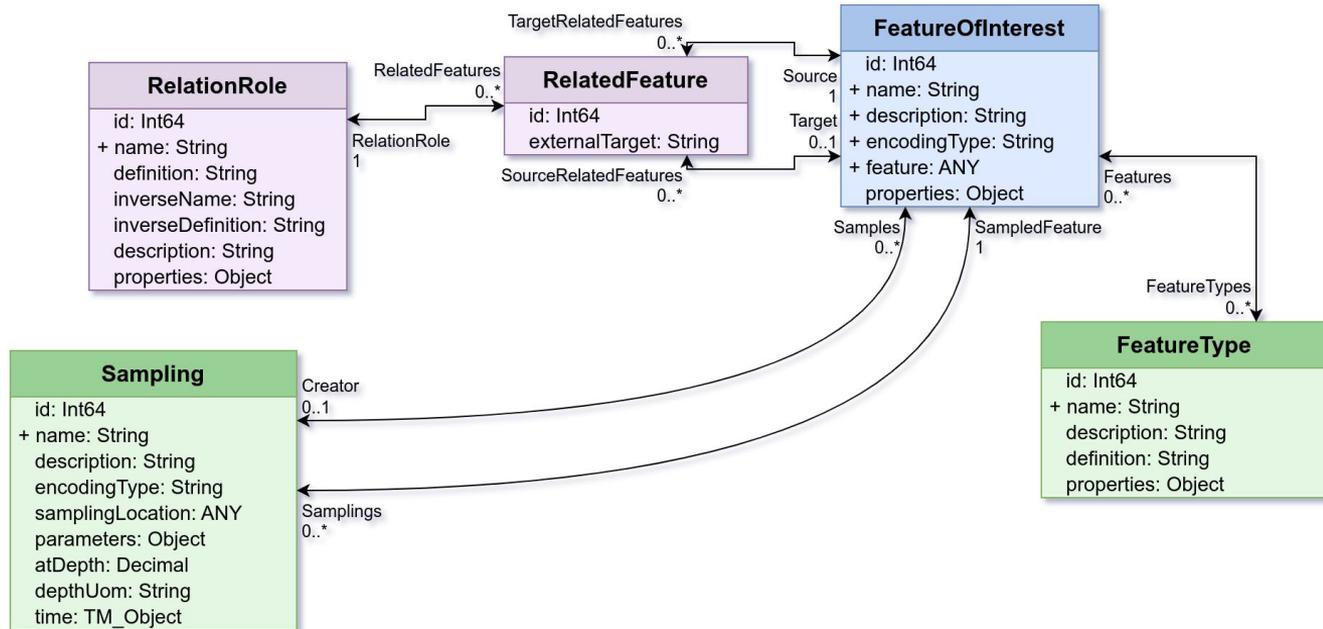
# STA 1.1 WQ-IE – Relations

## Relating Features to other Features

- + RelatedFeature
- + RelationRole

## The same for:

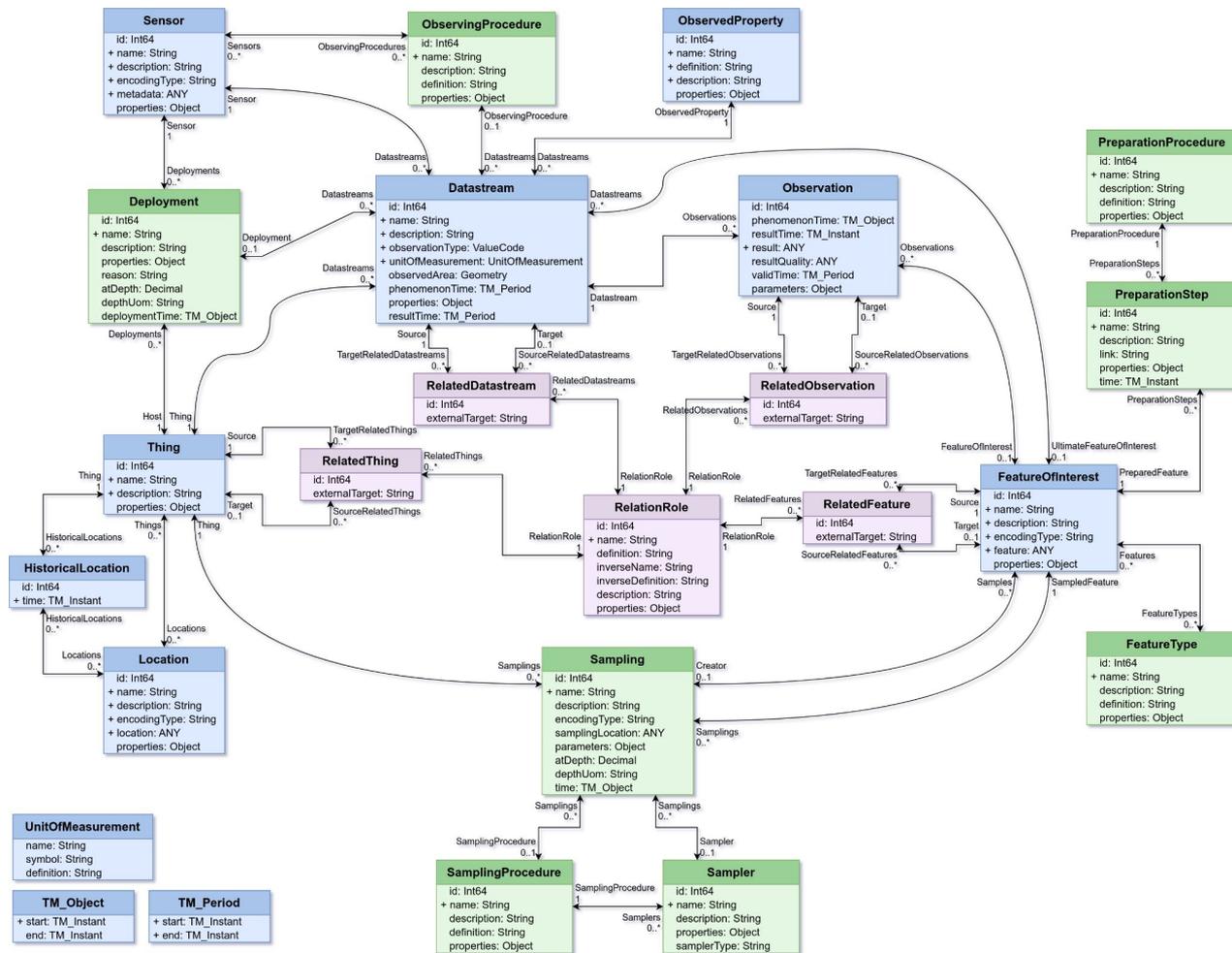
- + RelatedThing
- + RelatedDatastream
- + RelatedObservation



# STA 1.1 WQ-IE

Full data model

- Still v1.1 compatible





# Implementation

- Who
  - Water Quality IE members USGS, USEPA, DataStream (Canada), BRGM, BaFG (Unesco Gems water), ? Fraunhofer ?
  - EU Water4All partners
    - Ex : Danish DEP, ISPRA, VITO etc...
  - EU GSEU partners
    - Many EU geological surveys
- What
  - FROST Data Model Plugin  
<https://github.com/hylkevds/FROST-Server.Plugin.WaterQualityIE>
  - Docker Image  
<https://hub.docker.com/r/hylkevds/frost-http-waterquality>



# Implementation

- How
  - Documentation being written  
Google doc for now, will be moved to the GitHub when more mature  
[https://docs.google.com/document/d/1Oqjxrz8uY\\_Q9OKBwEM2ZufrCEnlYvA4vWIIJSiMyGT4/edit](https://docs.google.com/document/d/1Oqjxrz8uY_Q9OKBwEM2ZufrCEnlYvA4vWIIJSiMyGT4/edit)
- Demo endpoints
  - Open Free-For-All Service (no data yet)  
<https://ogc-demo.k8s.ilt-dmz.iosb.fraunhofer.de/FROST-WaterQuality/v1.1/>
  - USGS endpoint (work in progress)  
Data: <https://wqp.wqie.internetofwater.app/FROST-Server/v1.1>  
Map: <https://wqp.wqie.internetofwater.app/>  
Map: <https://wg-brgm.k8s.ilt-dmz.iosb.fraunhofer.de/servlet/is/211/>



# Landing the Interoperability Experiment

- When
  - Current target => OGC Member Meeting in June 2024
- What
  - Demo based on the implementation feedback
  - + draft Engineering Report
    - summarizing the findings from the IE
    - and proposing next steps. Ex : adoption of a Best Practice for Water Quality data exchange Water ML2.0 Part 5 and (potentially) a revision of WaterML2.0 Part 1 : TimeSeries



**Thank you**

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