



RÉPUBLIQUE  
FRANÇAISE

Liberté  
Égalité  
Fraternité



Géosciences pour une Terre durable

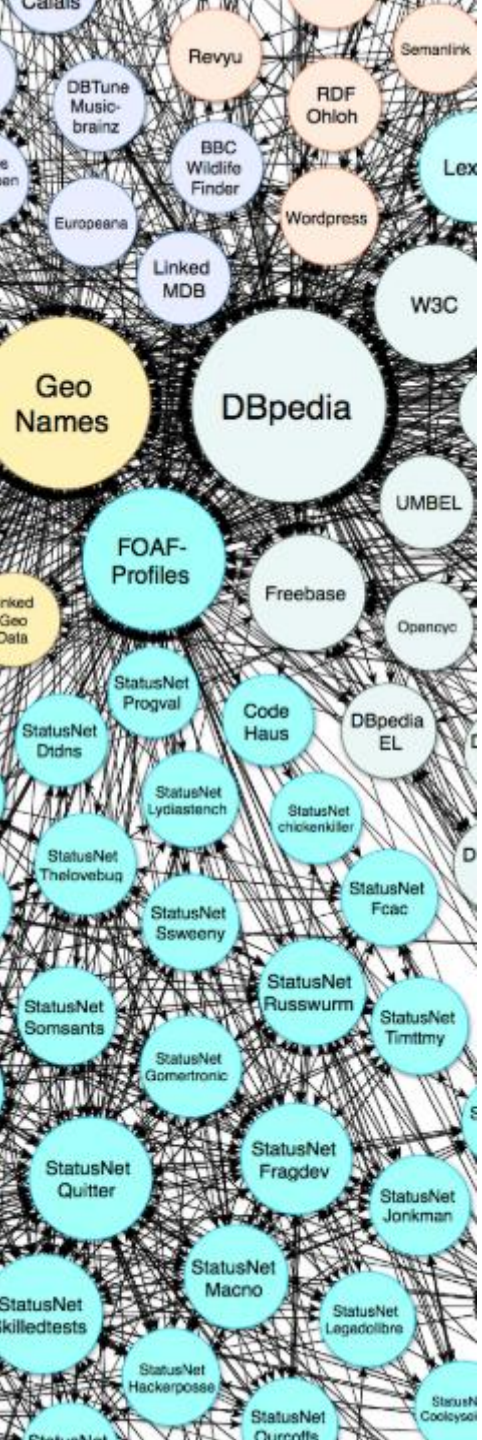
brgm

# THE INTEROPERABILITY TOOLBOX



Sylvain Grellet – BRGM  
ENSG – mastère GDM – 2023-01-20



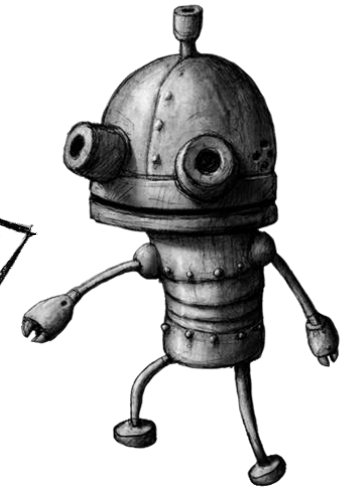
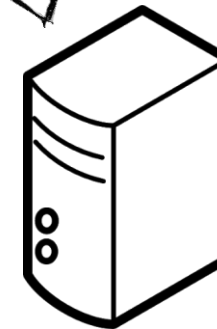
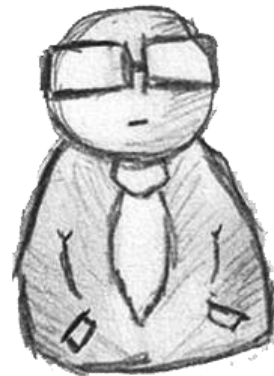


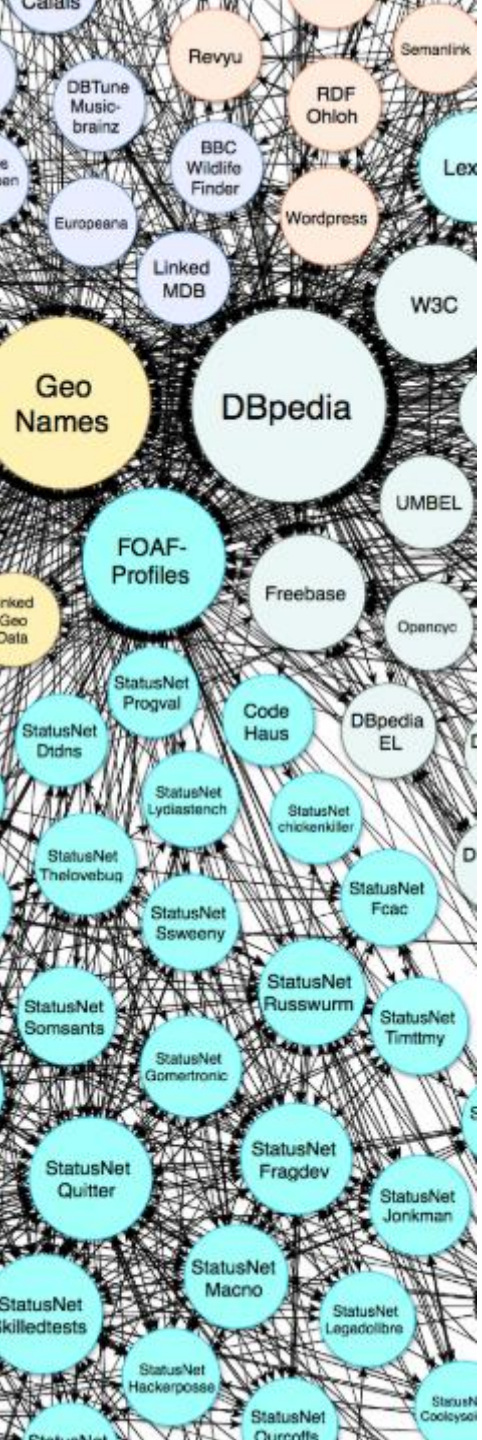
# Interoperability

## Draw me interoperability ...

« *The ability of a system or product to transfer meaning of information within and between systems or products without special effort on the part of the user* » Source : IEEE (Institute of Electrical and Electronics Engineers)

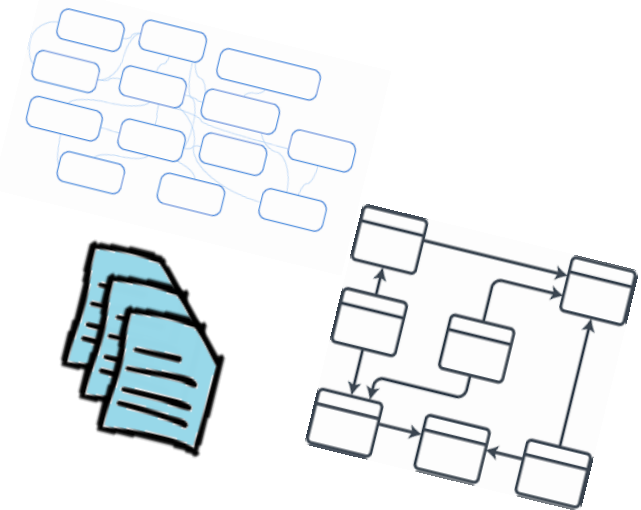
« *[...] la capacité que possède un produit ou un système à fonctionner avec d'autres produits ou systèmes existants ou futurs [...]* » Source : French government general interoperability framework





# Interoperability

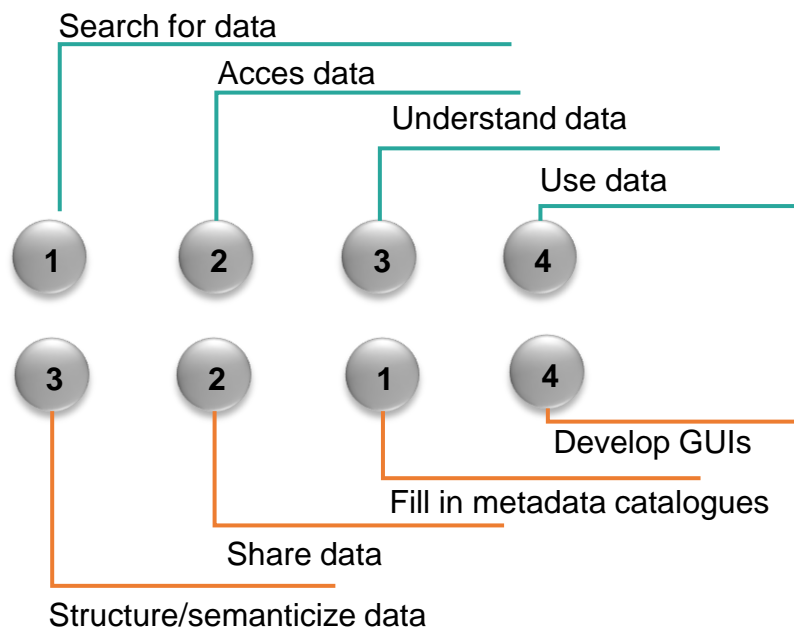
Challenges : numerous users, data heterogeneity, different needs



Domain expert 

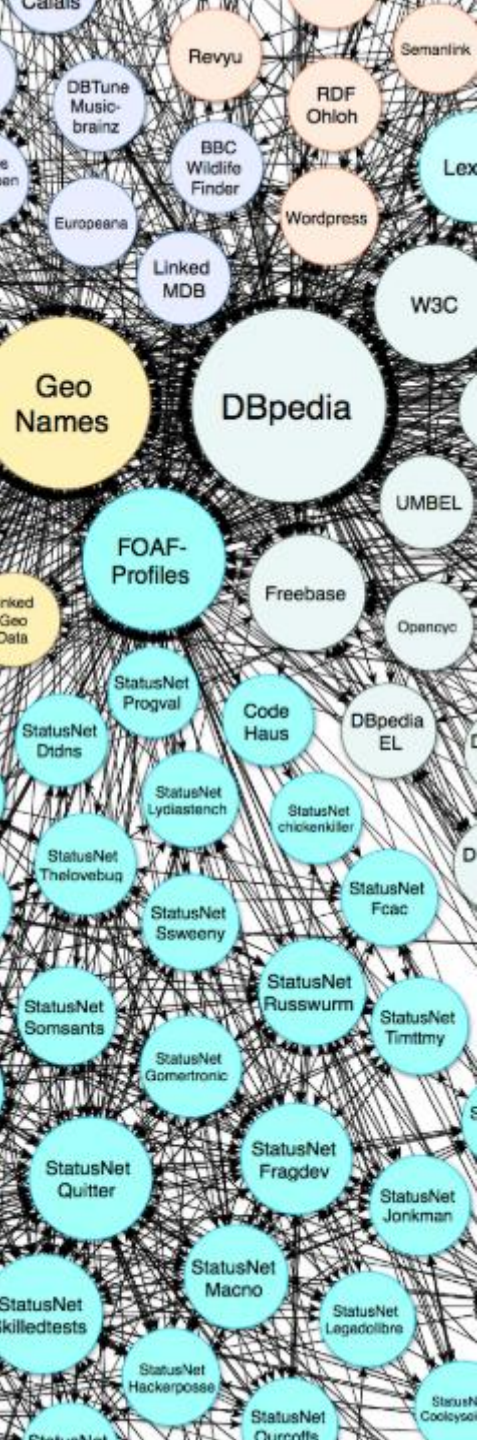
IT 

A different priority order



standardisation / FAIRification





# Interoperability

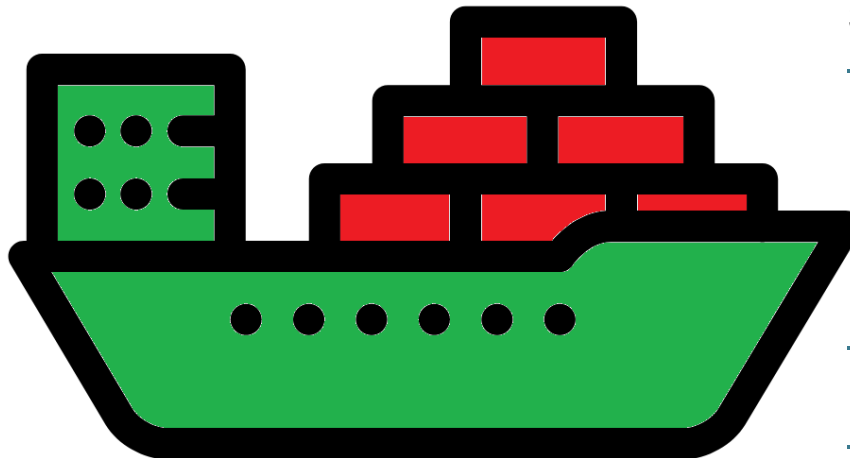
Towards more open standards

Standardisation of exchange methods

Standardisation of content exchanged

## Technical interoperability

- Mainly OGC services/API building on IETF, W3C work
- (Spatial) data on the web Best Practices : W3C
- Community / national standards : but not always compliant to the above mentioned



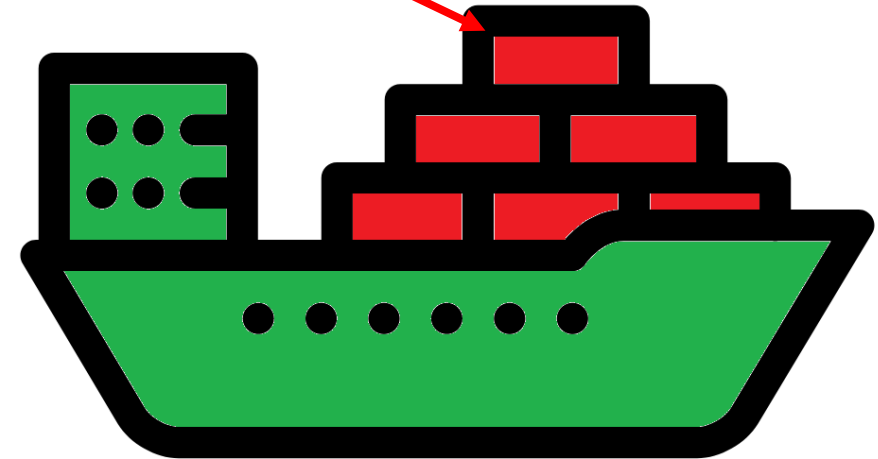
## Semantic interoperability

- International : ex. OGC (GeoSciML, EarthResourceML, HY\_Features, GroundWaterML2.0, etc.), RDA, W3C
- (Spatial) data on the web Best Practices : W3C
- Continental: ex. INSPIRE
- National: ex. Geonovum
- Community : ex . ChEBI

# Semantic interoperability







2 worlds we try to make work together

- UML
- Semantic Web approaches



# Semantic interoperability

## UML

- There are many OGC domain standards building around the ISO 191xx series of standards 
  - City, Aviation, Land Infrastructure, Geosciences (Geology, Hydrology, HydroGeology, Mineral Resources, etc.), Observations, ... 
- There are standards 
  - Having a legal value : INSPIRE, EU Environmental Directives reportings 
  - Validated by communities
- One important way to discover them
  - is through the OGC portal
  - but there are other out there => the entire INSPIRE directive specifications are based on those
- They are implemented country (ex : Australia, France, USA, ...) , continent (ex : INSPIRE), world (ex: International Union of Geological Science) and also organization wide (ex : World Meteorological Organisation)  
- Trend to go to open standards describing domains

# Semantic interoperability

## UML

- Underlying logic

- Model Driven Approach (MDA)

Defining a domain model that is independent from the IT implementation

=> We use UML to clarify the semantics of a given domain part/need

- 0°/ Use Cases definitions

- Data exchange Use Case not GUI Use Case

- 1°/ Defining the domain model

- With domain expert (called maieutics)
- IT Notation : UML with class diagrams (at least a Logical Model and sometimes Conceptual then Logical)
- Using ISO 191xx series of standards and already existing standards as basic Lego bricks

# Semantic interoperability

## UML

- Underlying logic

- Model Driven Approach (MDA)

Defining a domain model that is independent from the IT implementation

- 2°/ Going physical

- Previous 20 years rationale : UML -> XSD (applying 19118 and 19136 rules)
- Current target : JSON family (Geo-JSON, [OGC Features and Geometries JSON](#) ) which requires a different set of rules
- Current status : we are in an 'in-between' situation between maintaining compatibility with previous systems and applying new practices

- 3°/ Exposing data with the interoperable semantics

- Previous 20 years rationale : XML exposed by WebServices (WSDL, SOAP)
- Current target : JSON served by REST FUL APIs
- Current status : we are in an 'in-between' situation between maintaining compatibility with previous systems and applying new practices



# Semantic interoperability

## UML

- Basic bricks are defined by ISO TC 211 => ISO 191xx series of standards (notion of Feature, time primitive, geometry primitive, Observations & Measurements, Metadata, Quality information etc...)
  - From <https://github.com/ISO-TC211/HMMG/wiki>
    - Read-Only access : <http://iso.sparxcloud.com/index.php>
    - Direct Enterprise Architect project download
    - Can be directly “imported” in a project through Enterprise Architect ‘Reusable Assets’
- Building on those bricks various domain standards are made
  - Lets quickly meet some of them

# Semantic interoperability

## NAME : GEOSCIML

Logical model of geological features commonly described and portrayed in geological maps, cross sections, geological reports and databases.

Age : V 4.1

### Key features

- Covers the domain of geology (earth materials, geological units and stratigraphy, geological time, geological structures, geomorphology, geochemistry) and sampling features common to the practice of geoscience, such as boreholes and geological specimens.

### Weight

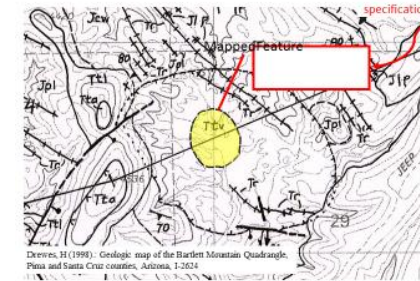
- Full and 'Lite' versions

### Children / Family

- Reused by many geological surveys and countries, continent wide spatial data/research infrastructures (INSPIRE, EPOS, AuScope, ...)

### Wishes

- Currently moving to the semantic web



Ttv Dacitic vent breccia—Light-medium-gray, finely porphyritic dacitic rock containing inclusions of Jurassic or Proterozoic granite and Jurassic rhyolite (welded tuff?) as much as 20 m in diameter. The subvertical outcrop mass of breccia probably is a volcanic vent or throat. A halo of strongly saussuritized rock 0.3–0.5 km wide surrounds this vent. The dacitic matrix consists of phenocrysts (25–35 percent, as much as 2 mm in length) set in a cryptocrystalline granular groundmass. Phenocrysts include albitized(?) plagioclase (12–18 percent), chloritized biotite (2–5 percent), unalitized amphibole (2–10 percent), magnetite (trace to 2 percent), and apatite (trace amount). Quartz is present as a secondary mineral, filling vugs.

- GeologicUnit
  - name: Dacitic vent breccia
  - geologicUnitType: LithodemicUnit
  - geologicHistory
    - GeologicEvent
      - name: Miocene
      - eventProcess: crystallisation
      - youngerNamedAge: Miocene
      - olderNamedAge: Miocene
  - composition
    - CompositionPart
      - proportion: 100%
      - role: dominant
      - material
        - RockMaterial
          - color: Light medium gray
          - lithology: Dacite
  - hierarchyLink
    - GeologicUnitHierarchy
      - role: inclusion
      - targetUnit
        - GeologicUnit
          - name: Rhyolite

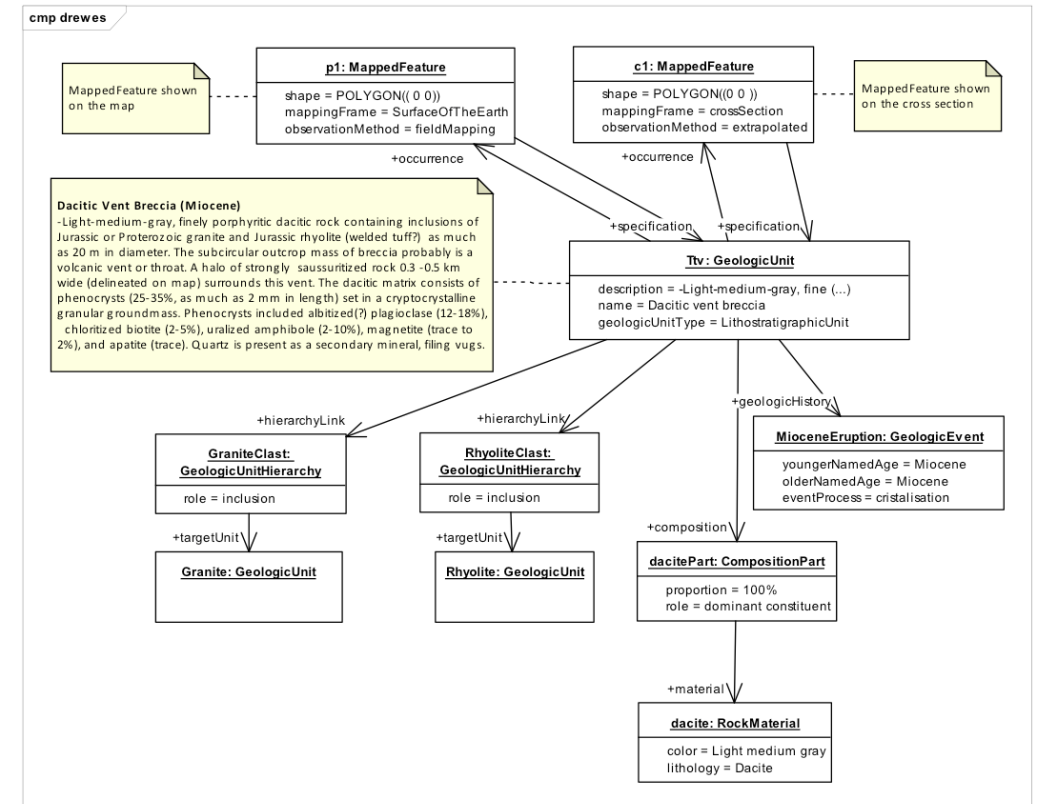
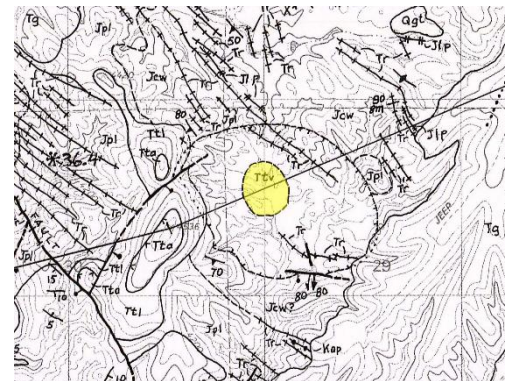
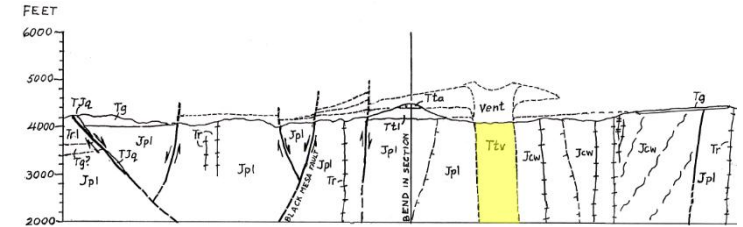
# Semantic interoperability

NAME : GEOSCIML

Contact

<https://www.opengeospatial.org/standards/geosciml>

Other pictures



# Semantic interoperability

**NAME : GROUNDWATERML2**

A conceptual and logical model for groundwater resources management

**Age : V 2.2**

## Key features

- Core groundwater elements such as aquifers, their pores, and fluid bodies,
- Wells and construction component, springs, and monitoring sites
- Observations: constituents (bio, chemical, materials constituent), groundwater flow within/between containers,
- AquiferTest / pump test

## Weight

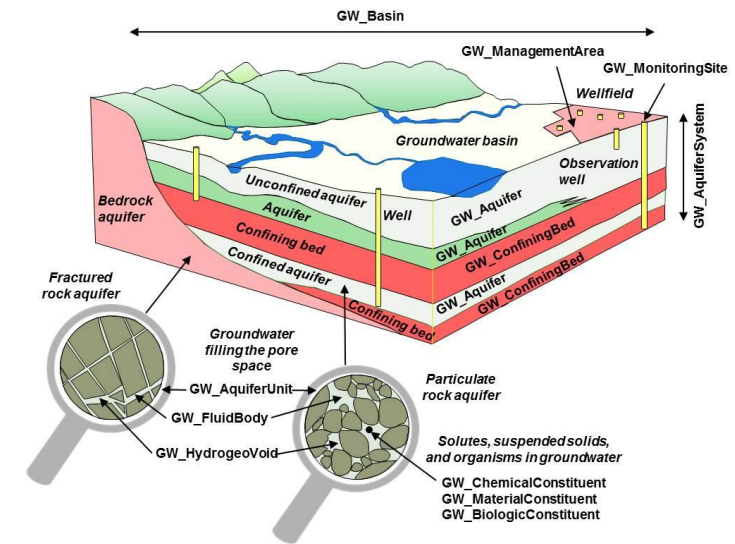
- Full and draft 'Lite' versions

## Children / Family

- Reused by many geological surveys

## Wishes

- Currently moving to the semantic web



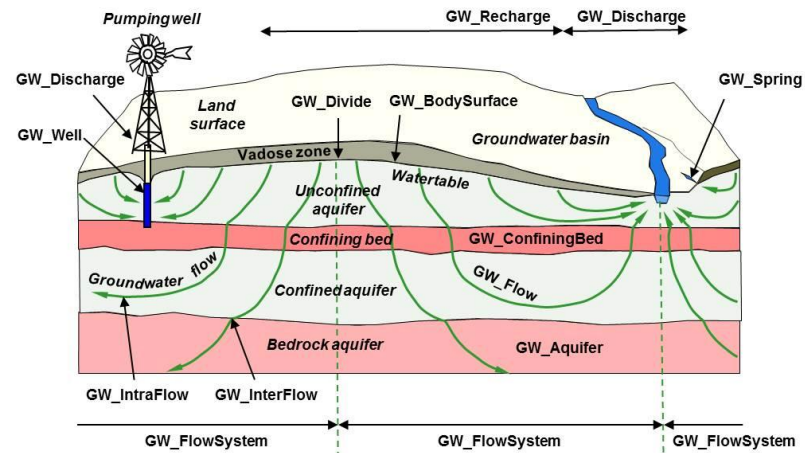
# Semantic interoperability

**NAME : GROUNDWATERML2**

**Contact**

<https://www.opengeospatial.org/standards/gwml2>

**Other pictures**



# Semantic interoperability

## NAME : SURFACE HYDROLOGY FEATURES (HY\_FEATURES)

A conceptual model describing hydrology features and their relationships independent of their geometric representation and scale.

Age : V 1.0

### Key features

- Hydrology specific feature types, e.g. catchments, drainage networks, rivers, lakes and waterbodies, hydrometric features
- Focus is on surface water features and the networks they form.

### Weight

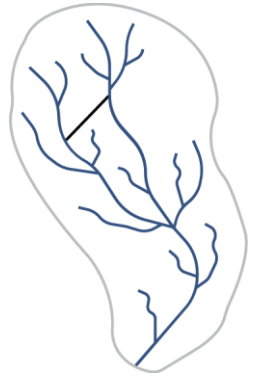
- Full version

### Children / Family

- USGS, NrcAN, BRGM, AU Hydrological Geo Fabric

### Wishes

- Has moved to the semantic web



# Semantic interoperability

## NAME : SURFACE HYDROLOGY FEATURES (HY\_FEATURES)

### Contact

<http://docs.opengeospatial.org/is/14-111r6/14-111r6.html>

[http://opengeospatial.github.io/HY\\_Features/HY\\_Features\\_primer/HY\\_Features\\_Primer.html#/](http://opengeospatial.github.io/HY_Features/HY_Features_primer/HY_Features_Primer.html#/)

### Other pictures

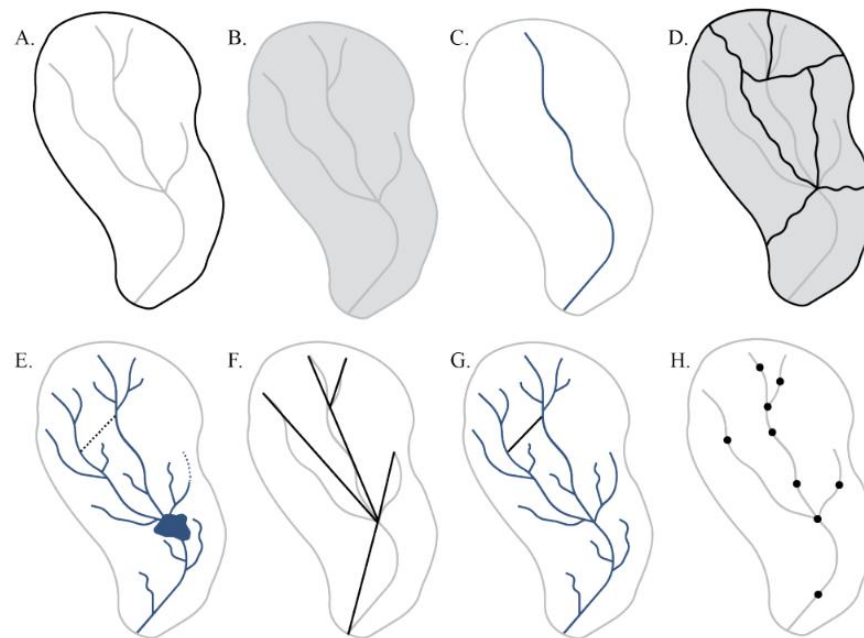
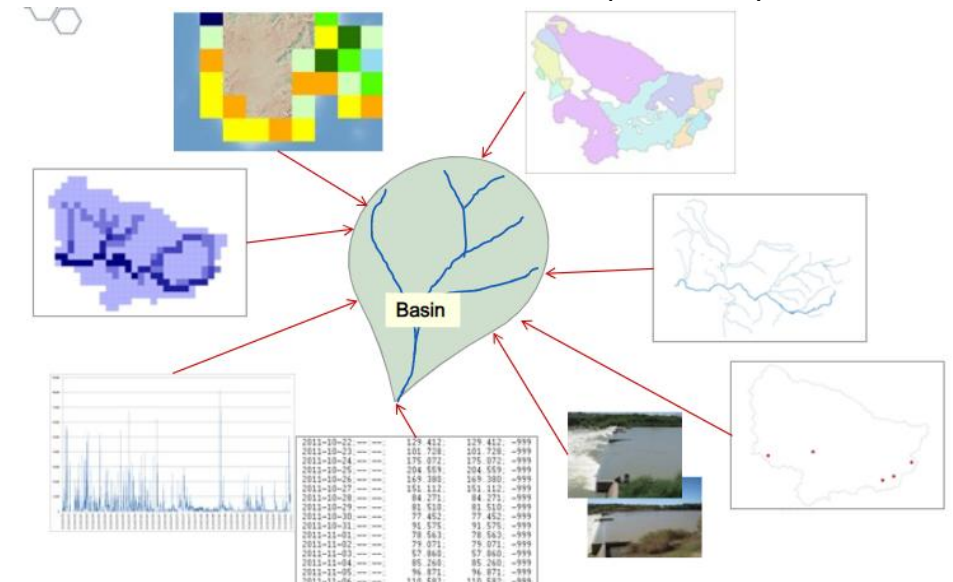


Figure 5. Multiple catchment realizations (top left to bottom right): a) catchment boundary, b) catchment area, c) catchment flowpath d) subcatchment network, e) hydrographic network, f) geo-schematic network, g) flow network, h) hydrometric network of monitoring stations.

## Global Runoff Data Centre (GRDC)



# Semantic interoperability

## NAME : EARTHRESOURCEML

Logical model for the exchange of digital information for mineral occurrences, mines and mining activity.

Age : V 2.0

### Key features

- Geological features of mineral occurrences, their commodities, mineral resources and reserves
- Mines and mining activities, and the production of concentrates, refined products, and waste materials.

### Weight

- Full and 'Lite' versions

### Children / Family

- Reused by many geological surveys and countries, continent wide spatial data/research projects (INSPIRE, Minerals4EU, EPOS, AuScope, ...)

### Wishes

- Currently moving to the waste <sup>16</sup> (urban mine, secondary raw materials)





# Semantic interoperability

**NAME : EARTHRESOURCEML**

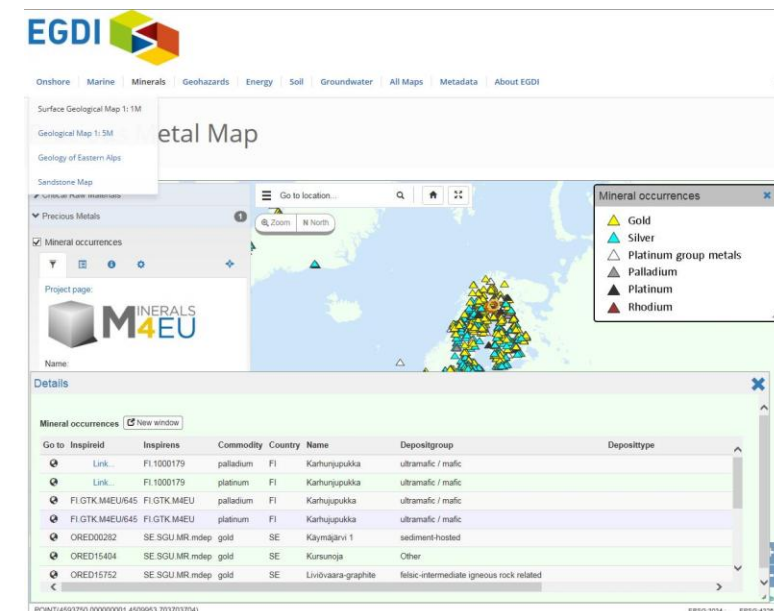
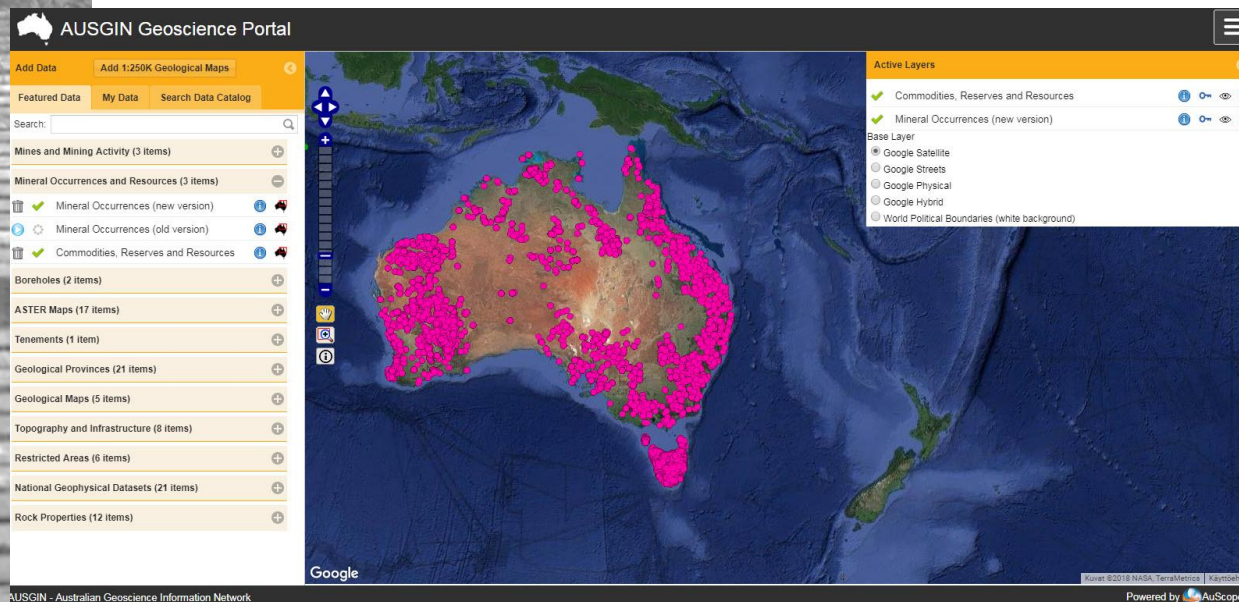
**Contact**

<http://www.earthresourceml.org/>

**Comments**

Is not OGC but IUGS/CGI (where GeoSciML incubated), is connected to GeoSciML and driven by the 'same' experts.

**Other pictures**



# Semantic interoperability

## NAME : OBSERVATIONS, MEASUREMENTS & SAMPLES

Conceptual and logical model for observations and features involved in sampling when making observations for the exchange of information within and between different scientific and technical communities.

Age : V 2.0 (revision just finishing)

### Key features

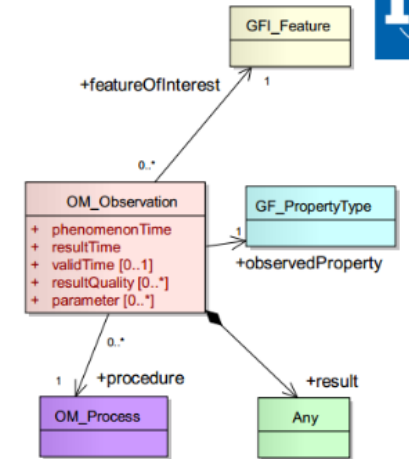
- Description of the observation acts and their results
- A common set of sampling feature types classified primarily by topological dimension, as well as samples for ex-situ observations.
- Relationships between sampling features (subsampling, derived samples)

### Weight

- Full and 'Lite' versions

### Children / Family

- Many international reuse by communities, profiles





# Semantic interoperability

## NAME : OBSERVATIONS, MEASUREMENTS & SAMPLES

### Wishes

- Just arrived in the semantic web -> W3C: SOSA/SSN

### Contact

<https://www.opengeospatial.org/standards/om>

### Comments

- Previous domain standards **all refer to / build on Observations and Measurements** (ISO 19156:2011)
- International ISO Standard (ISO 19156:2011 “Observations & Measurements” -> now updated into 19156:2022 “Observations, Measurements & Samples”)
- Major uptake in
  - Domains (see next slide)
  - Also standardization bodies (ex : W3C SSN/SOSA)

# Semantic interoperability

## NAME : OBSERVATIONS, MEASUREMENTS & SAMPLES

Other pictures

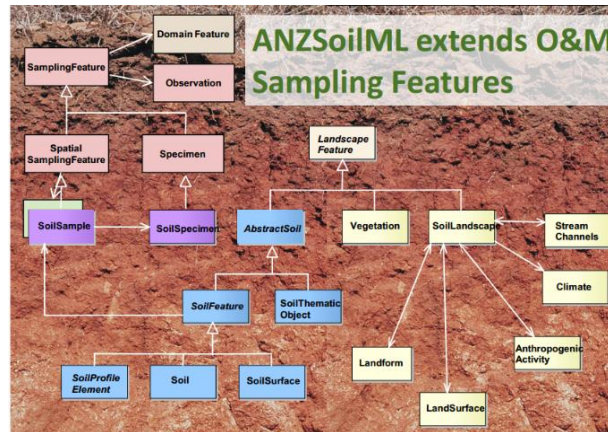
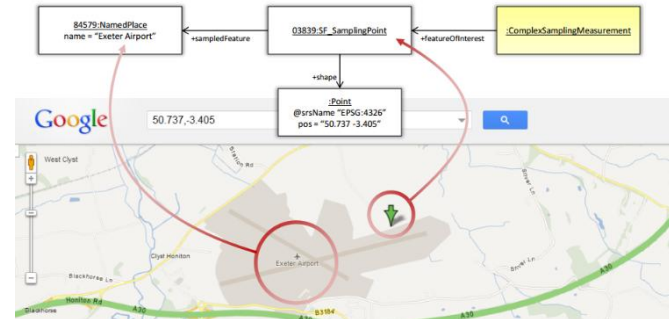
(note all based on the 2011 version)

WMO 'METeorological Community Exchange' model

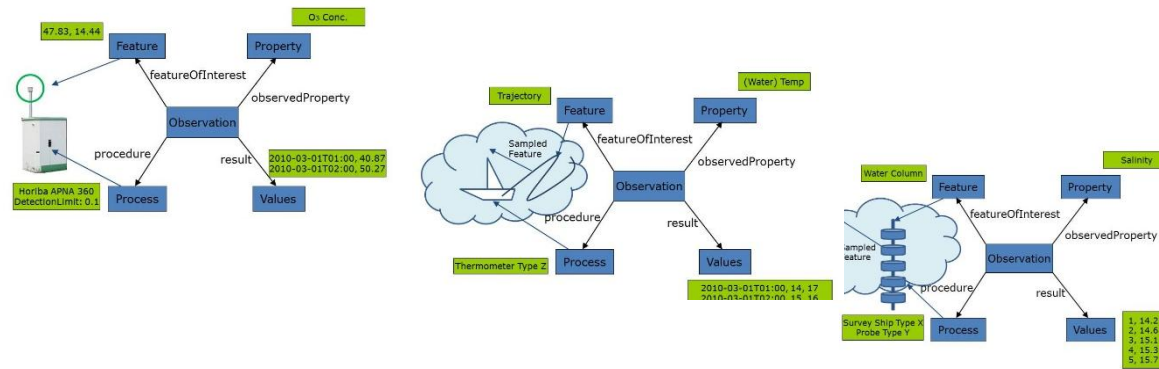


SamplingFeature as OM\_Observation.featureOfInterest

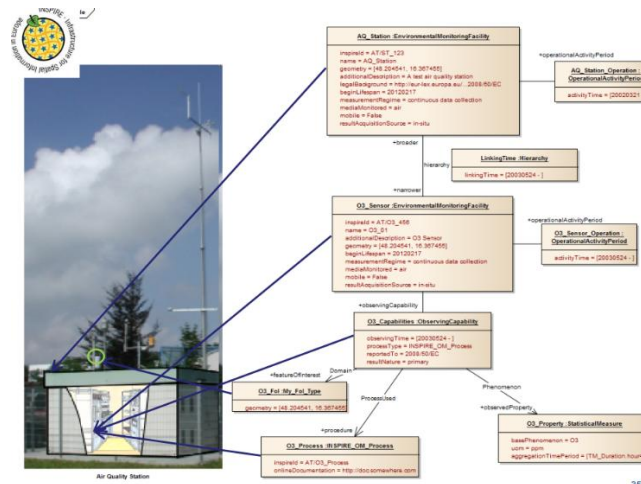
In meteorology, we define a sampling regime that enables us to observe, measure or simulate the real-world. Sampling Features (from ISO 19156 'Observations and measurements') provide a way to characterise this sampling regime and the relationship to the real-world.



EU INSPIRE guidelines for O&M



EU Air Quality Directive



# Semantic interoperability

## UML

- All those 'OGC' Geoscience Domain standards are linked

### Observations & Measurements

EarthResourceML

GeoSciML

GroundWaterML

HY\_Features

currently reaching out to  
Infrastructure and BIM standards

City GML

LandInfra / InfraGML

bSI/BIM

*Note: Other could have been mentioned, like OGC WaterML2 Part 1& TimeseriesML, Soil Interoperability Experiment (IE), Borehole IE\*, etc...*

*\* <https://github.com/opengeospatial/BoreholeIE>*

# Semantic interoperability

## UML

- Lets meet some of them continued
  - [INSPIRE Data Specification](#) : all based on ISO 191xx series of standards, some themes are aligned with OGC standards

### ANNEX: 1



[Addresses](#)



[Cadastral parcels](#)



[Geographical grid systems](#)



[Hydrography](#)



[Transport networks](#)



[Administrative units](#)



[Coordinate reference systems](#)



[Geographical names](#)



[Protected sites](#)

### ANNEX: 2



[Elevation](#)



[Land cover](#)



[Geology](#)



[Orthoimagery](#)



# Semantic interoperability

## UML

- Lets meet some of them continued
  - Need to mention all models defined in national information systems, Research Infrastructures, communities (ex: Energistics – not fully 191xx compliant but highly implemented, ...)
  - That's a lot of Lego® boxes to play with when starting a new project rather than inventing it's own wheel !





# Semantic interoperability

## Semantic Web approaches

- Re the session you had with Benedicte Bucher
  - Open World Assumption -> ontologies
  - There are activities to have an “equivalent” ontology for some of the previously mentioned standards
    - Observations & Measurements, HY\_Features, GeoSciML, GroundWaterML2.0
- The specific case of ‘nomenclatures’, ‘controlled vocabularies’ / ‘codeList’, ‘lexicons’

# Semantic interoperability

## Semantic Web approaches

- The specific case of 'nomenclatures', 'controlled vocabularies' / 'codeList', 'lexicons'

No. Carbone	Alcane R-H : préfixe	Alcane R-H : suffixe	Formule : C <sub>n</sub> H <sub>2n+2</sub>	Alkyle R : préfixe	Alkyle R : suffixe	Formule de R-	Abréviation
1	méth	ane	CH <sub>4</sub>	méth	yle	CH <sub>3</sub> -	Méth(a)
2	éth	ane	CH <sub>3</sub> CH <sub>3</sub>	éth	yle	CH <sub>3</sub> CH <sub>2</sub> -	Éth(a)
3	prop	ane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub>	prop	yle	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> -	Prop(a)
4	but	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>3</sub>	but	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> -	But(a)
5	pent	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	pent	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>2</sub> -	Pent(a)
6	hex	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	hex	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>2</sub> -	Hex(a)
7	hept	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub>	hept	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>2</sub> -	Hept(a)
8	oct	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>6</sub> CH <sub>3</sub>	oct	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>6</sub> CH <sub>2</sub> -	Oct(a)
9	non	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> CH <sub>3</sub>	non	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> CH <sub>2</sub> -	Non(a)
10	déc	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> CH <sub>3</sub>	déc	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> CH <sub>2</sub> -	Déc(a)
11	undéc	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>9</sub> CH <sub>3</sub>	undéc	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>9</sub> CH <sub>2</sub> -	Undéc(a)
12	dodéc	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> CH <sub>3</sub>	dodéc	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> CH <sub>2</sub> -	Dodéc(a)
13	tridéc	ane	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>11</sub> CH <sub>3</sub>	tridéc	yle	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>11</sub> CH <sub>2</sub> -	Tridéc(a)

Nomenclature des parties d'ouvrages d'art en béton armé et précontraint © 1976 SETRA-LCPC

Nom de la partie d'ouvrage	DEFINITION	Croquis ou photo.
<b>BARRETTE</b> (en paroi moulée)	ÉLÉMENT DE PAROI EN BÉTON OU EN BÉTON ARMÉ, MOULÉ DANS LE SOL OU PRÉFABRIQUÉ, ISOLÉ OU COMBINÉ AVEC D'AUTRES POUR FORMER UN PROFIL.	
<b>BARRIÈRE</b> (de sécurité)	DISPOSITIF DE SECURITÉ DESTINÉ A MAINTENIR SUR LA PLATE-FORME UN VÉHICULE LOURD EN PERDITION (ET REMPLISSANT ÉGALEMENT CE RÔLE POUR LES VÉHICULES LÉGERS).	
<b>BATARDEAU</b>	OUVRAGE DE PROTECTION, PROVISOIRE OU DÉFINITIF, PERMETTANT DE TRAVAILLER A L'AIR LIBRE PLUS BAS QUE LE NIVEAU DE L'EAU.	
<b>BAVETTE</b>	DISPOSITIF DÉFORMABLE PERMETTANT DE RECUEILLIR DES EAUX. EXEMPLE : BAVETTE SOUS JOINT DE CHAUSSÉE.	

Code	Intitulés de la NAF rév. 2, version finale	Intitulés NAF rév. 2, en 65 caractères	Intitulés NAF rév. 2, en 40 caractères
<b>SECTION A</b>	<b>AGRICULTURE, SYLVICULTURE ET PÊCHE</b>	<b>AGRICULTURE, SYLVICULTURE ET PÊCHE</b>	<b>AGRICULTURE, SYLVICULTURE ET PÊCHE</b>
<b>01</b>	<b>Culture et production animale, chasse et services annexes</b>	<b>Culture et production animale, chasse et services annexes</b>	<b>Cult. &amp; prod. animale, chasse &amp; sce ann.</b>
<b>01.1</b>	<b>Cultures non permanentes</b>	<b>Cultures non permanentes</b>	<b>Cultures non permanentes</b>
01.11	Culture de céréales (à l'exception du riz), de légumineuses et de graines oléagineuses	Culture de céréales (sf riz) légumineuses, graines oléagineuses	Cult céréale, légumineuse, graine oléag.
01.11Z	Culture de céréales (à l'exception du riz), de légumineuses et de graines oléagineuses	Culture de céréales (sf riz) légumineuses, graines oléagineuses	Cult céréale, légumineuse, graine oléag.
01.12	Culture du riz	Culture du riz	Culture du riz
01.12Z	Culture du riz	Culture du riz	Culture du riz
01.13	Culture de légumes, de melons, de racines et de tubercules	Culture de légumes, de melons, de racines et de tubercules	Cult. légume, melon, racine & tubercule
01.13Z	Culture de légumes, de melons, de racines et de tubercules	Culture de légumes, de melons, de racines et de tubercules	Cult. légume, melon, racine & tubercule
01.14	Culture de la canne à sucre	Culture de la canne à sucre	Culture de la canne à sucre
01.14Z	Culture de la canne à sucre	Culture de la canne à sucre	Culture de la canne à sucre
01.15	Culture du tabac	Culture du tabac	Culture du tabac
01.15Z	Culture du tabac	Culture du tabac	Culture du tabac
01.16	Culture de plantes à fibres	Culture de plantes à fibres	Culture de plantes à fibres
01.16Z	Culture de plantes à fibres	Culture de plantes à fibres	Culture de plantes à fibres
01.19	Autres cultures non permanentes	Autres cultures non permanentes	Autres cultures non permanentes
01.19Z	Autres cultures non permanentes	Autres cultures non permanentes	Autres cultures non permanentes
<b>01.2</b>	<b>Cultures permanentes</b>	<b>Cultures permanentes</b>	<b>Cultures permanentes</b>
01.21	Culture de la vigne	Culture de la vigne	Culture de la vigne
01.21Z	Culture de la vigne	Culture de la vigne	Culture de la vigne

# Semantic interoperability

## Semantic Web approaches

- The specific case of 'nomenclatures', controlled vocabularies' / 'codeList', 'lexicons'
  - Structured using WebSem/Linked Data Best Practice and made available for

Human

and

Machines

Entrée: Conductivité de l'eau à 25°C

URI: <https://data.geoscience.fr/ncl/ObsProp/191>

Conductivité électrique de l'eau mesurée ou corrigée à 25°C.

## Définition

category	Eaux souterraines
description	Water conductivity measured at 25°C   Conductivité électrique de l'eau mesurée ou corrigée à 25°C.
exact match	electrical conductivity water at 25 c
in scheme	Propriétés Observées
label	Conductivité de l'eau à 25°C   Water conductivity at 25°C
notation	191
pref label	Water conductivity at 25°C   Conductivité de l'eau à 25°C
same as	1303
status	Validé
top concept of	Propriétés Observées
type	quantity kind   groundwater observed property   Concept   physical observed property
unit	MicroSiemens par centimètre

## Liens

Exact match pour

- [electrical conductivity water at 25 c](#)

In concept scheme

- [Propriétés Observées](#)

Est même que

- [1303](#)

Est top concept de

- [Propriétés Observées](#)

```
@prefix schema: <https://schema.org/> .
@prefix ssd: <http://www.w3.org/ns/spargl-service-description#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix qb: <http://purl.org/linked-data/cube#> .
@prefix dgu: <http://reference.data.gov.uk/def/reference/> .
@prefix ui: <http://purl.org/linked-data/registry-ui#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix reg: <http://purl.org/linked-data/registry#> .
@prefix api: <http://purl.org/linked-data/api/vocab#> .
@prefix vann: <http://purl.org/vocab/vann/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix cc: <http://creativecommons.org/ns#> .
@prefix void: <http://rdfs.org/ns/void#> .
@prefix adms: <http://www.w3.org/ns/adms#> .
@prefix org: <http://www.w3.org/ns/org#> .
@prefix odrs: <http://schema.theodi.org/odrs#> .
@prefix env-ui: <http://environment.data.gov.uk/registry/structure/ui/> .
@prefix version: <http://purl.org/linked-data/version#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix ldp: <http://www.w3.org/ns/ldp#> .
@prefix time: <http://www.w3.org/2006/time#> .
@prefix vs: <http://www.w3.org/2003/06/sw-vocab-status/ns#> .
@prefix dc: <http://purl.org/dc/elements/1.1/> .
```

```
<https://data.geoscience.fr/ncl/ObsProp/191>
a
  <http://qudt.org/schema/qudt/QuantityKind> , <https://data.geoscience.fr/def/main#GroundwaterObservedProperty> , skos:Concept ,
  <https://data.geoscience.fr/def/main#PhysicalObservedProperty> ;
rdfs:label
  "Conductivité de l'eau à 25°C"@fr , "Water conductivity at 25°C"@en ;
dct:description
  " Water conductivity measured at 25°C"@en , " Conductivité électrique de l'eau mesurée ou corrigée à 25°C."@fr ;
reg:category
  <https://data.geoscience.fr/ncl/structure/Category/4> ;
<http://qudt.org/2.1/schema/qudt#unit>
  <https://data.geoscience.fr/ncl/uom/463> ;
owl:sameAs
  <http://id.eaufrance.fr/par/1303> ;
skos:exactMatch
  <http://registry.it.csiro.au/def/environment/property/electrical_conductivity_water_at_25C> ;
skos:inScheme
  <https://data.geoscience.fr/ncl/ObsProp> ;
skos:notation
  "191" ;
skos:prefLabel
  "Water conductivity at 25°C"@en , "Conductivité de l'eau à 25°C"@fr ;
skos:topConceptOf
  <https://data.geoscience.fr/ncl/ObsProp> ;
adms:status
  <http://inspire.ec.europa.eu/registry/status/valid> .
```

```
<https://data.geoscience.fr/ncl/ObsProp/191>
a
  reg:RegisterItem ;
rdfs:label
  "Water conductivity at 25°C"@en , "Conductivité de l'eau à 25°C"@fr ;
dct:dateAccepted
  "2020-04-10T14:04:28.202Z"^^xsd:dateTime ;
dct:dateSubmitted
  "2020-04-10T14:03:04.892Z"^^xsd:dateTime ;
dct:description
  " Water conductivity measured at 25°C"@en , " Conductivité électrique de l'eau mesurée ou corrigée à 25°C."@fr ;
dct:modified
  "2021-12-02T09:50:48.802Z"^^xsd:dateTime ;
reg:entity
  [
    reg:entity <https://data.geoscience.fr/ncl/ObsProp/191> ;
    reg:sourceGraph <https://data.geoscience.fr/ncl/ObsProp/191:5#graph>
  ] ;
reg:itemClass
  <https://data.geoscience.fr/def/main#GroundwaterObservedProperty> , <http://qudt.org/schema/qudt/QuantityKind> , skos:Concept ,
  <https://data.geoscience.fr/def/main#PhysicalObservedProperty> ;
```



## Entrée: Conductivité de l'eau à 25°C

URI: <https://data.geoscience.fr/ncl/ObsProp/191>

Conductivité électrique de l'eau mesurée ou corrigée à 25°C.

Globally unique and persistent identifier

## Définition Descriptive properties

<b>category</b>	Eaux souterraines
<b>description</b>	Water conductivity measured at 25°C   Conductivité électrique de l'eau mesurée ou corrigée à 25°C.
<b>exact match</b>	<a href="#">electrical conductivity water at 25 c</a> <span style="color: blue;">References to other vocabularies</span>
<b>in scheme</b>	Propriétés Observées
<b>label</b>	Conductivité de l'eau à 25°C   Water conductivity at 25°C
<b>notation</b>	191
<b>pref label</b>	Water conductivity at 25°C   Conductivité de l'eau à 25°C
<b>same as</b>	<a href="#">1303</a> <span style="color: blue;">References to other vocabularies</span>
<b>status</b>	Validé
<b>top concept of</b>	Propriétés Observées
<b>type</b>	quantity kind   groundwater observed property   Concept   physical observed property
<b>unit</b>	MicroSiemens par centimètre

## Liens

Exact match pour

- [electrical conductivity water at 25 c](#)

In concept scheme

- [Propriétés Observées](#)

Est même que

- [1303](#)

Est top concept de

- [Propriétés Observées](#)



## Entrée: Conductivité de l'eau à 25°C

URI: <https://data.geoscience.fr/ncl/ObsProp/191>

Conductivité électrique de l'eau mesurée ou corrigée à 25°C.

Globally unique and persistent identifier

### Définition

Descriptive property

category	Eaux souterraines
description	Water conductivity measured at 25°C   Conductivité mesurée ou corrigée à 25°C. <i>skos:exactMatch =&gt; reference to a skos concept</i>
exact match	<a href="#">electrical conductivity water at 25 c</a>
in scheme	Propriétés Observées
label	Conductivité de l'eau à 25°C   Water conductivity
notation	191
pref label	Water conductivity at 25°C   Conductivité de l'eau
same as	1303
status	Validé
top concept of	Propriétés Observées
type	quantity kind   groundwater observed property   observed property
unit	MicroSiemens par centimètre

## Entry: water electrical conductivity @ 25C

URI: [http://registry.it.csiro.au/def/environment/property/electrical\\_conductivity\\_water\\_at\\_25C](http://registry.it.csiro.au/def/environment/property/electrical_conductivity_water_at_25C)  
water electrical conductivity @ 25C

CSIRO equivalent

### Definition

References to other vocabularies

broader	electrical conductivity of water   electric conductivity
description	water electrical conductivity @ 25C
feature of interest	liquid water
generalization	electric conductivity   electrical conductivity of water
label	water electrical conductivity @ 25C
pref label	water electrical conductivity @ 25C
source	eReefs
type	electricity and magnetism quantity kind   Concept   scaled quantity kind
unit	micro siemens per centimetre   milligrams per litre

### Links

Has broader concept

- electric conductivity
- electrical conductivity of water

Feature of interest

- liquid water

Has more general quantity kind

- electric conductivity
- electrical conductivity of water

Has unit of measure

- micro siemens per centimetre
- milligrams per litre



Entrée: Conductivité de l'eau à 25°C

URI: <https://data.geoscience.fr/ncl/ObsProp/191>

Conductivité électrique de l'eau mesurée ou corrigée à 25°C.

Définition

Descriptive properties

category	Eaux souterraines
description	Water conductivity measured at 25°C   Conductivité électrique de l'eau mesurée ou corrigée à 25°C.
exact match	electrical conductivity water at 25 c
in scheme	Propriétés Observées
label	Conductivité de l'eau à 25°C   Water conductivity at 25°C
notation	191
pref label	Water conductivity at 25°C   Conductivité de l'eau à 25°C
same as	<a href="#">1303</a> <a href="#">References to other vocabularies</a>
status	Validé <i>owl:sameAs =&gt; reference to a resource having similarity</i>
top concept of	Propriétés Observées
type	quantity kind   groundwater observed property   Concept   physical observed property
unit	MicroSiemens par centimètre

## JEUX DE DONNEES DE REFERENCE

PARAMÈTRES



### Conductivité à 25°C

Code Sandre : 1303

Statut : **Validé**

Proposer une modification

Noter cette fiche : ★★★★★

Télécharger :



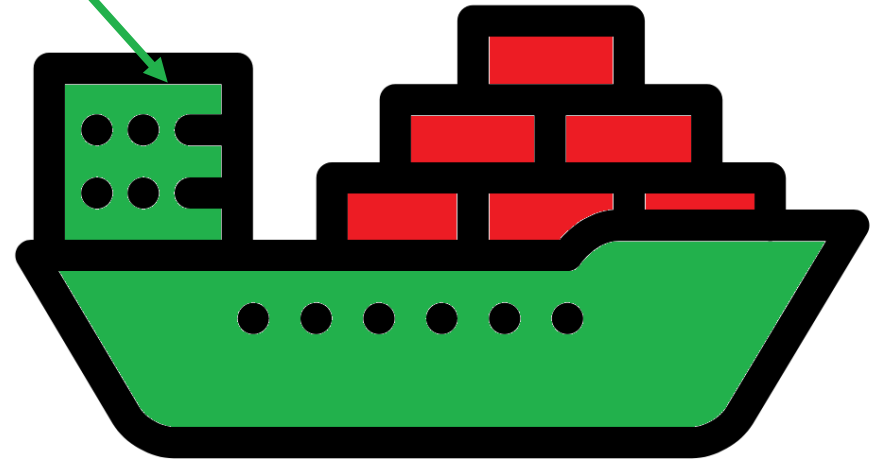
Informations	Groupes de Paramètres	Historique	Statistiques
<b>Conductivité à 25°C est un(e) paramètre physique quantitatif du groupe de classe Physique [32]</b>			
Date de création du paramètre	19/08/1987		
Date de la dernière mise-à-jour du paramètre	22/06/2015		
Nom du paramètre	Conductivité à 25°C		
Nature du paramètre	Paramètre physique quantitatif		
Définition du paramètre	Conductivité électrique de l'eau mesurée ou corrigée à 25°C.		
Paramètre calculé	<a href="#">Paramètre élémentaire</a>		
Libellé long du paramètre	Conductivité		



# Technical interoperability

## 2 ways to access data

- Through Webservices / API
- Direct access to a resource



# Technical interoperability

## Through Webservices / API

- A paradigm shift

3 July 2018

*Latest version of Web Feature Service standard aligns with the current architecture of the Web and the joint OGC-W3C Spatial Data on the Web Best Practices.*



The Open Geospatial Consortium (OGC) seeks public comment on the latest version of the Web Feature Service standard: WFS 3.0. The WFS 3.0 development has been conducted in a public manner with contributions from the wider geospatial community occurring through a [GitHub repository](#) and in a [public hackathon](#).

An OGC Web Feature Service (WFS) offers the capability to retrieve, create, modify and query spatial data on the Web.

All versions of the WFS standard have so far used a Remote-Procedure-Call-over-HTTP architectural style using XML for any payloads as it was state-of-the-art in the late 1990s and early 2000s, when WFS was originally designed. The next version (WFS 3.0) is intended to provide a modern alternative and will specify a modernized service that aligns with the current architecture of the Web and the joint OGC-W3C [Spatial Data on the Web Best Practices](#). The key changes relate to its architecture, encodings, reuse, modularization, schemas, and security.

As a result of this modernization, WFS 3.0 implementations will not be backwards compatible with WFS 2.0 implementations per se. However, a design goal is to define WFS 3.0 in a way so that the WFS 3.0 interface can be mapped to an WFS 2.0 implementation.

WFS 3.0 is intended to be simpler and more modern, but still an evolution from the previous versions and their implementations.

The WFS standard is a multi-part document. This first part specifies the core capabilities that every WFS has to support and is restricted to read-access to spatial data. Additional capabilities that address specific needs will be specified in additional parts. Examples include support for creating and modifying data, more complex data models, richer queries, and additional coordinate reference systems.

*An overview of the modernization of WFS3.0, including the key changes, is available in the GitHub repository: [The next version of WFS - an overview](#).*



# Technical interoperability

## Through Webservices / API

- A paradigm shift triggered by
  - The fact that (geo) data was under-used by the web community even after big pushes of initiatives like INSPIRE
  - The generalisation of Resource oriented architecture (RESTful APIs) based on resource identification through URIs and using HTTP protocol to interact with them
  - The raise in maturity of frameworks such as [OData](#) and [Swagger/OpenAPI](#)

⇒ bottom line: the web community was looking away from the previous approaches

  - The collaboration between OGC/W3C initiated around 2014 and producing important milestones
    - Data on the Web Best Practices : <https://www.w3.org/TR/dwbp/>
    - Spatial Data on the Web Best Practices : <https://www.w3.org/TR/sdw-bp/>- This paradigm shift is valid for all the previous generations OGC Web Services (OWS stack)
  - Most of the new APIs are now under 'OGC API – xxx' (ex : WFS 3 is now [OGC API – Features](#))

# Technical interoperability

## Through Webservices / API



### Tiles

Approved Standard

OGC API - Tiles provides extended functionality to other OGC API Standards to deliver vector tiles, map tiles, and other tiled data.

[More Info](#)

[GitHub repo](#)



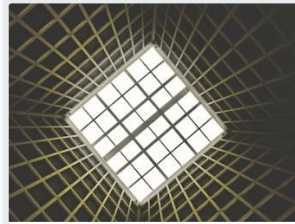
### Processes

Approved Standard

OGC API - Processes allows for processing tools to be called and combined from many sources and applied to data in other OGC API resources through a simple API.

[More Info](#)

[GitHub repo](#)



### Coverages

OGC API - Coverages allows discovery, visualization and query of complex raster stacks and data cubes.

[More Info](#)

[GitHub repo](#)

## APIs for the Web



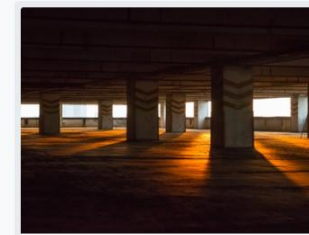
### Features

Approved Standard

OGC API - Features - Part 1: Core and Part 2: Coordinate Reference Systems by Reference are both publicly available.

[More Info](#)

[GitHub repo](#)



### Common

OGC API - Common provides those elements shared by most or all of the OGC API standards to ensure consistency across the family. The candidate standard will soon be released for public review.

[More Info](#)

[GitHub repo](#)



### EDR

Approved Standard

Environmental Data Retrieval (EDR) API provides a family of lightweight interfaces to access Environmental Data resources. Each resource addressed by an EDR API maps to a defined query pattern.

[More Info](#)

[GitHub repo](#)



### Records

OGC API - Records updates OGC's Catalog Services for the Web by building on the simple access to content in OGC API - Features.

[More Info](#)

[GitHub repo](#)



### Styles

The OGC API - Styles defines a Web API that enables map servers, clients as well as visual style editors, to manage and fetch styles...

[More Info](#)

[GitHub repo](#)



### Maps

OGC API - Maps offers a modern approach to the OGC Web Map Service (WMS) standard for provision map and raster content.

[More Info](#)

[GitHub repo](#)

# Technical interoperability

- Through Webservices / API

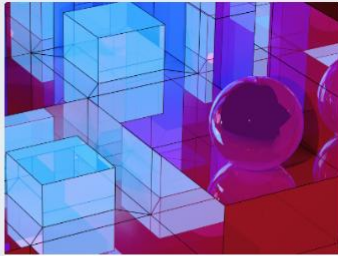


## Moving Features

OGC API - Moving Features defines an API that provides access to data representing features that move as rigid bodies.

[More Info](#)

[GitHub repo](#)



## 3D GeoVolumes

OGC API - 3D GeoVolumes facilitates efficient discovery of and access to 3D content in multiple formats based on a space-centric perspective.

[More Info](#)

[GitHub repo](#)



## DGGS

Enables applications to organise and access data arranged according to a Discrete Global Grid System (DGGS).

[More Info](#)

[GitHub repo](#)



## Routes

Enables applications to request routes in a manner independent of the underlying routing data set, routing engine or algorithm.

[More Info](#)

[GitHub repo](#)



## Joins

OGC API - Joins supports the joining of data, from multiple sources, with feature collections or directly with other input files.

[More Info](#)

[GitHub repo](#)

## APIs for the IoT



## SensorThings


The OGC SensorThings API provides an open, geospatial-enabled and unified way to interconnect Internet of Things (IoT) devices, data, and applications over the Web.

[More Info](#)

[GitHub repo](#)

# Technical interoperability

## Through APIs

- Each API instance described by a documentation that is meaningful for the Web
- No retrocompatibility is not an issue
- Targetting « JSON family » (often (Geo)JSON) representation
- Hypermedia (  )
  - [Hypermedia as the Engine of Application State](#)
  - Within API operation
  - Within data structure returned: Sensor Things API response is a perfect example
  - ⇒ “A REST client needs little to no prior knowledge about how to interact with an application or server beyond a generic understanding of hypermedia.” (Wikipedia)
  - ⇒ A client could work by following links between resources, that's the way of the modern Web





# Technical interoperability

## Through APIs - exemples

- OGC Sensor Things API
  - Comes with a Feature model to respect (compliant to Observations & Measurements) => see dedicated OMS SensorThings API presentation (4\_OMS\_ST\_API).

```
{
  "@iot.nextLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams?$skip=100",
  "value": [
    {
      "name": "Dichloropropène-2,3 in Eau on Eau brute at LA GRANDE NOUE D'HERMÉ A GOUAIX 1 with method Qualité de l'eau - Dosage par chromatographie en phase gazeuse d'un certain nombre d'hydrocarbures aromatiques monocycliques, du naphthalène et de divers composés chlorés par dégazage, piégeage et désorption thermique (T90-129/NF EN ISO 15680 01/2004)",
      "description": "Dichloropropène-2,3 in Eau on Eau brute at LA GRANDE NOUE D'HERMÉ A GOUAIX 1 with method Qualité de l'eau - Dosage par chromatographie en phase gazeuse d'un certain nombre d'hydrocarbures aromatiques monocycliques, du naphthalène et de divers composés chlorés par dégazage, piégeage et désorption thermique (T90-129/NF EN ISO 15680 01/2004)",
      "properties": {↔},
      "observationType": "http://www.opengis.net/def/observationType/OGC-OM/2.0/OM_Measurement",
      "observedArea": {
        "type": "Point",
        "coordinates": [
          48.457967041,
          3.296382646
        ]
      }
    },
  ],
  "phenomenonTime": "2010-01-04T00:20:00.000Z/2011-11-02T11:55:00.000Z",
  "Sensor@iot.navigationLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams(1142553)/Sensor",
  "Thing@iot.navigationLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams(1142553)/Thing",
  "Observations@iot.navigationLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams(1142553)/Observations",
  "unitOfMeasurement": {↔},
  "ObservedProperty@iot.navigationLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams(1142553)/ObservedProperty",
  "@iot.id": 1142553,
  "@iot.selfLink": "https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0/Datastreams(1142553)"
}
```

# Technical interoperability

## Through APIs – some considerations

- RESTful
  - A RESTful API really make use of HTTP verbs to interact with it
  - And NOT ONLY GET => ok reading is nice but a truly RESTful API allows much more
  - PUT, PATCH, « DELETE » and other are also useful
- ⇒ A really good example OGC SensorThings API



# Technical interoperability

## Through APIs – some considerations

- Deploying a home made/brewd RESTful API using Swagger/OpenAPI or OData is NOT playing the FAIR data / interoperability game
  - Ex : setting up an API to access River in France and the USA
    - In France could be `/.../ecoulement/coursEau` ("operationId": "getResultats",)
    - In the USA `/.../flow/waterbodies` ("operationId": "getFeatures")
  - Each operation awaiting its own parameters to execute domain queries
    - River Network Semantics : In France based on the BD Topage semantics, in the USA on NHD+,
    - Generic parameters : BBOX, outputFormat
  - Each API returning a payload with its own 'local' semantics (re BD Topage VS NHD+)
- ⇒ How can on share information in a Machine2Machine approach with no mapping/re-wiring ?
- ⇒ Semantic and technical interoperability are not provided
  
- ⇒ Advised solution
  - API : OGC API – Features
  - Semantics : OGC/WMO Hy\_Features which by specifications is mapped to both US, France, INSPIRE models.

# Technical interoperability

Direct access to a resource and Linked Data

- Resolvers allow to externally reference a resource via its URI (a PID)

<https://data.geoscience.fr/id/hydrogeounit/121AS01>

HTTP

content negotiation

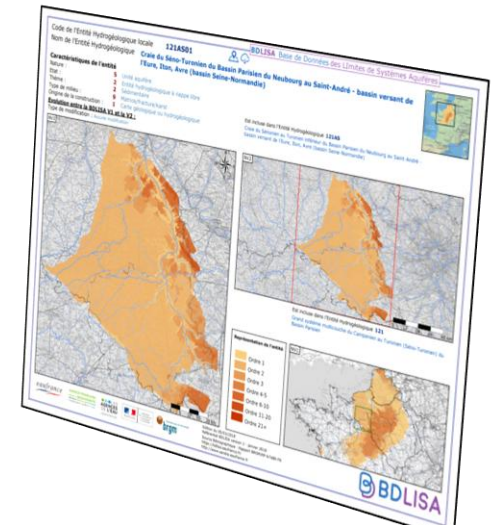
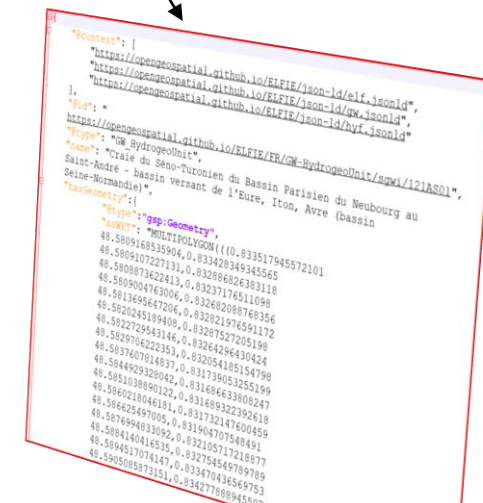
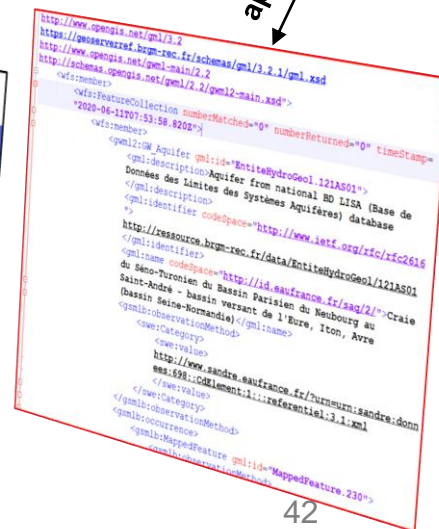
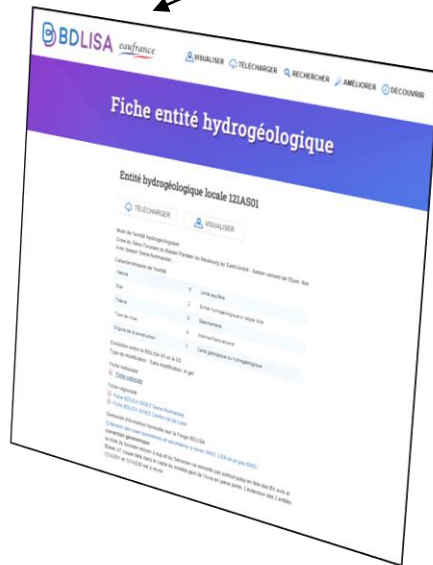
text/html

application/gml+xml

application/ld+json

application/pdf

Etc...



# Technical interoperability

## Direct access to a resource and Linked Data

- HTTP content negotiation
  - Used in everyday life (standard web browser defines the media type and language)
  - But is highly useful for Machine2Machine data exchange
- Currently evolving to '[Content negotiation by profile](#)'. Interesting additions
  - the possibility for a resource and for the same media-type to serve it according to different model (called profile)
  - the possibility for a client to 'test/probe' the available media-type x profile x etc... availables

Definitions Server Home Search Browse Vocabularies About

System Home / Vocabularies / HY\_Features HydroFeature package / HY\_CatchmentArea

### Concept

**Preferred Label**

**HY\_CatchmentArea**

**URI**

[https://www.opengis.net/def/schema/hy\\_features/hyf/HY\\_CatchmentArea](https://www.opengis.net/def/schema/hy_features/hyf/HY_CatchmentArea)

**Within Vocab**

HY\_Features HydroFeature package

**Definition**

The HY\_CatchmentArea feature type realizes a catchment specifically as a catchment area connecting the inflow and outflow of the catchment it realizes. HY\_CatchmentArea specializes HY\_CatchmentRealization with respect to an implied areal geometric representation. Topologically, the catchment area connecting the inflow and outflow of the catchment is a face bounded inwards by an inflow edge and outwards by an outflow edge. Hydrologically, catchment area refers to the area having a common outlet for its runoff. Through generalization, HY\_CatchmentArea inherits the shape and the realizedCatchment properties. The optional shape of the catchment may be implemented as a surface.

[HY\\_CatchmentRealization](#)

<http://www.w3.org/2002/07/owl#Class>

<http://www.opengis.net/def/metadata/FeatureType>

**Broader Object Type**

**Alternate Profiles**

Different views and formats:

[Alternate Profiles ?](#)

OGC definition server example

VocPrez Home About VocPrez SPARQL Vocabularies

**Resource** [https://www.opengis.net/def/schema/hy\\_features/hyf/HY\\_CatchmentArea](https://www.opengis.net/def/schema/hy_features/hyf/HY_CatchmentArea)

**Alternate Representations**

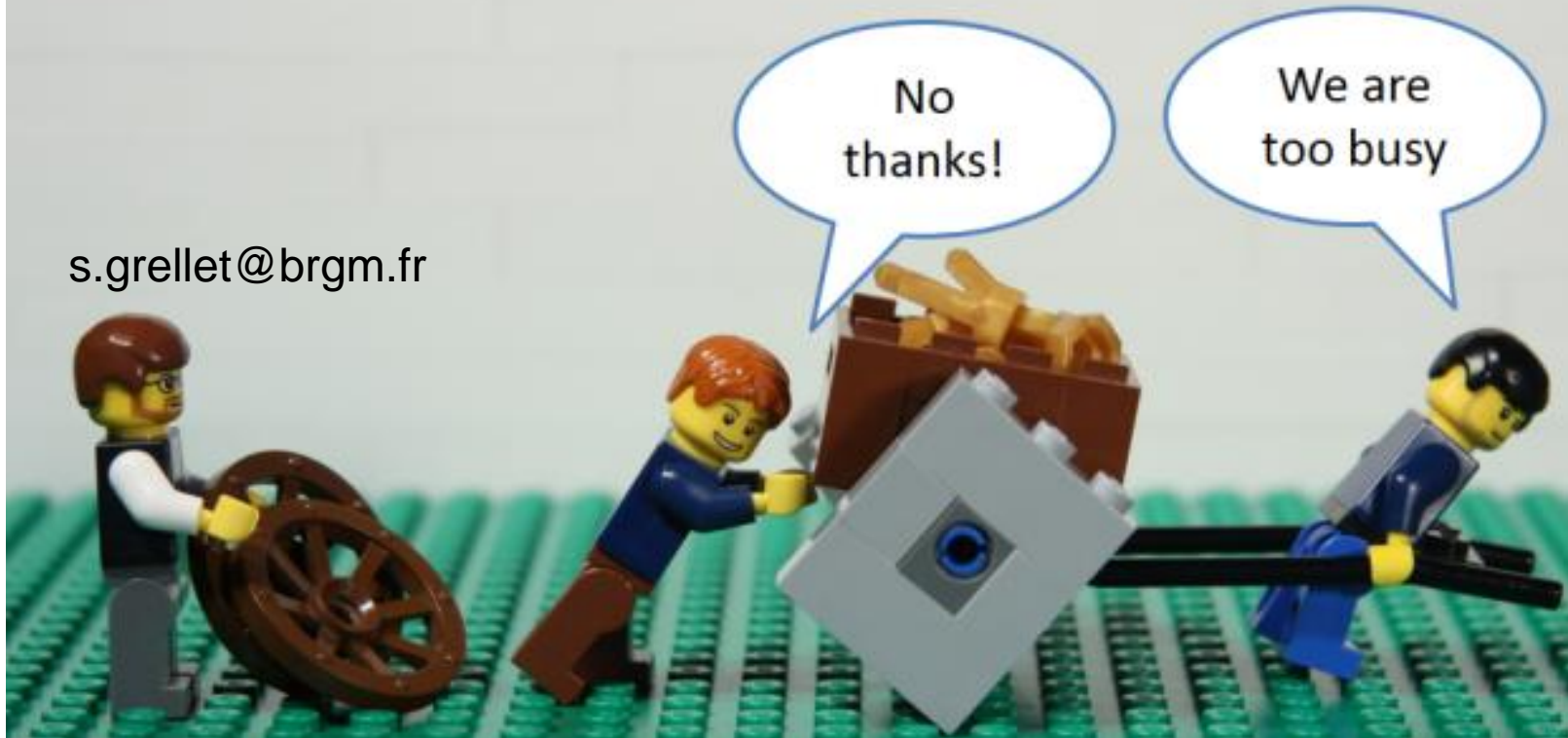
Profile	Short Token	Media Types
alt views	alt	<ul style="list-style-type: none"><li>• <a href="#">application/ld+json</a></li><li>• <a href="#">text/html</a></li><li>• <a href="#">text/turtle</a></li><li>• <a href="#">application/json</a></li><li>• <a href="#">application/rdf+xml</a></li></ul>
SKOS concept	concept	<ul style="list-style-type: none"><li>• <a href="#">text/html</a></li><li>• <a href="#">application/json</a></li><li>• <a href="#">application/rdf+xml</a></li><li>• <a href="#">text/turtle</a></li></ul>
Default object view	describe	<ul style="list-style-type: none"><li>• <a href="#">text/html</a></li><li>• <a href="#">application/json</a></li><li>• <a href="#">application/rdf+xml</a></li><li>• <a href="#">text/turtle</a></li></ul>

Thank you



Are you too busy to improve?

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This illustration is inspired by and in part derived from the work by Scott Simmerman, "The Square Wheels Guy" <http://www.performancecompany.com/>

# Thanks to

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