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# ‘Linked data’ the glue within interoperable information systems

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# 'LINKED DATA' THE GLUE WITHIN INTEROPERABLE INFORMATION SYSTEMS

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Geoscience for a sustainable Earth

**brgm**

# CONTEXT

‘Previous generation’ of OGC APIs (ex: WFS, SOS)

based on design from the 90's, 2000 (RPC, SOAP)

## Brought SDIs to the web but

- Are opaque to the web (and crawlers)
  - need to know the catalogue where to search for the API end-point
  - need to know how to interact with the such catalogue
  - when the API end-point is found, need to RTFM of the API spec

=> We expose(d) data in a siloed way

Idea n°1: Data is naturally linked  
-> why not linking data content ?

# (1) ? LINKING DATA CONTENT ?

## Still using 'Previous generation' OGC APIs

- Assigning HTTP URIs
  - Applying W3C best practices (Data on the web, Spatial Data on the web)
- Links
  - Between features
    - Station to river,
    - AquiferSystem to its part, ...
  - To controlled vocabularies

# (1) ? LINKING DATA CONTENT ?

- Example

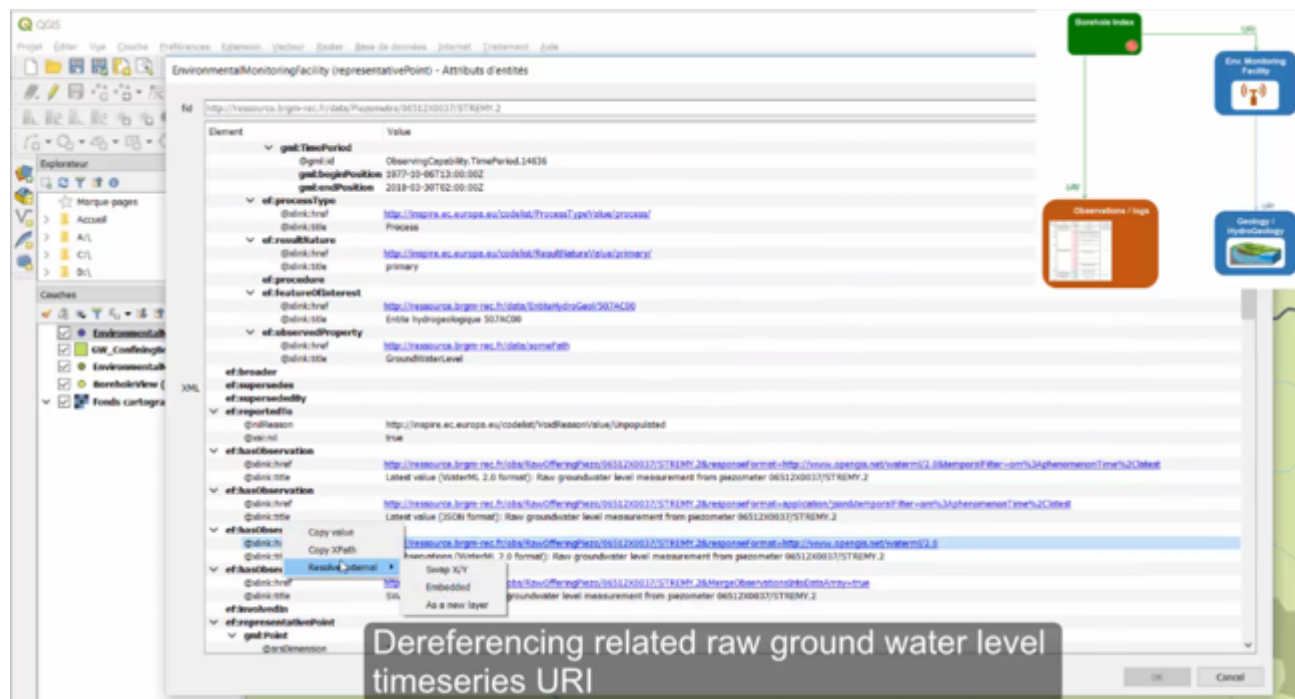
```
<gwfml2:GW_AquiferSystem gml:id="EntiteHydroGeol.121AS">
  <gml:description>Aquifer from national BD LISA (Base de Données des Limites des Systèmes Aquifères) database</gml:description>
  <gml:identifier codeSpace="http://www.ietf.org/rfc/rfc2616">https://data.geoscience.fr/id/hydrogeounit/121AS</gml:identifier>
  <gml:name codeSpace="http://id.eaufrance.fr/isaq/2/"> Craie du Sénonien au Turonien inférieur du Bassin Parisien du Neubourg au Saint-André - bassin versant de l'Eure, Iton, Avre (ba
  <gsmlb:observationMethod>
    <swe:Category>
  </gsmlb:observationMethod>
  <gsmlb:occurrence>
  <gsmlb:purpose>instance</gsmlb:purpose>
  <gsmlb:geologicUnitType xlink:href="http://resource.geosciml.org/classifier/cgi/geologicunittype/hydrogeologic_unit" xlink:title="Hydrogeologic Unit"/>
  <gsmlb:rank xlink:href="http://id.eaufrance.fr/nsa/352#2" xlink:title="Régional"/>
  <gwfml2:gwUnitMedia xlink:href="http://id.eaufrance.fr/nsa/353#9" xlink:title="Triple porosité : matricielle et karstique et de fractures"/>
  <gwfml2:gwAquiferSystem xlink:href="https://data.geoscience.fr/id/hydrogeounit/121" xlink:title="Grand système multicouche du Campanien au Turonien (Seno-Turonien) du Bassin Parisien du Neubourg au Saint-André - bassin versant de l'Eure, Iton, Avre (bassin Seine-Normandie)"/>
  <gwfml2:gwAquiferSystemPart xlink:href="https://data.geoscience.fr/id/hydrogeounit/121AS01" xlink:title="Craie du Séno-Turonien du Bassin Parisien du Neubourg au Saint-André - bassin versant de l'Eure, Iton, Avre (bassin Seine-Normandie)"/>
  <gwfml2:gwAquiferSystemPart xlink:href="https://data.geoscience.fr/id/hydrogeounit/121AS30" xlink:title="Craie marseuse et marnes du Turonien inférieur du Bassin Parisien du Neubourg au Saint-André - bassin versant de l'Eure, Iton, Avre (bassin Seine-Normandie)"/>
</gwfml2:GW_AquiferSystem>
```

URI to Feature

URI to codeList

# (1) ? LINKING DATA CONTENT ?

- From this you can already build nice things



See :

[https://github.com/BRGM/gml\\_application\\_schema\\_toolbox/tree/master/presentations/2018\\_INSPIRE\\_conference](https://github.com/BRGM/gml_application_schema_toolbox/tree/master/presentations/2018_INSPIRE_conference)

Even between 'Previous generation' OGC APIs that's already a better experience

# (1) ? LINKING DATA CONTENT ?

## Still using 'Previous generation' OGC APIs

- Data content starts to open up
  - -> start to cross silos
  - -> that's already a better experience
- But
  - API are still opaque to the web
  - Data semantics unaccessible to the web of data

Idea n°2: Why not serving data in a web oriented approach ?

## (2) ? SERVING DATA IN A WEB ORIENTED APPROACH ?

### New OGC APIs

- Important turn/change in OGC specs
  - Web APIs, sometimes referred to as RESTful services.
  - 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 (HATEOAS)
  - Within API operation
  - Within data structure returned: perfect example of ST API response
  - -> A client could work by following links between resources, that's the way of the modern Web





## (2) ? SERVING DATA IN A WEB ORIENTED APPROACH ?

### New OGC APIs

- SensorThings 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)"
    }
  ]
}
```

## (2) ? SERVING DATA IN A WEB ORIENTED APPROACH ?

### New OGC APIs

- APIs endpoint can be automatically discovered (by machines)
- But
  - Data semantics unaccessible to the web of data

Idea n°3: Why not expressing data semantics differently ?

## (3) ? EXPRESSING DATA SEMANTICS DIFFERENTLY ?

### Using web of data oriented semantics

- OGC ELFIE / SELFIE (<https://opengeospatial.github.io/ELFIE/> )
  - 2018 – 2019 ELFIE: OGC and W3C standards with the goal of establishing a best practice for exposing links between and among environmental domain and sampling features in a highly adaptable standards compliant way that is compatible with modern web search technology.
  - 2019 – 2020 SELFIE: designing and vetting Web-resource model and network behavior for cross-domain linked feature data that compliments and uses new OGC APIs as a building block.
- JSON-LD serialization/model of choice
- Semantics
  - Schema.org for indexing by search engines
  - Complemented by ontologies stemming from OGC, INSPIRE semantics, W3C, ...
- Content negotiation on HTTP URIs

# (3) ? EXPRESSING DATA SEMANTICS DIFFERENTLY ?

## Using web of data oriented semantics

- Controlled vocabulary Registry
  - Being federated at the EU level

Outil de gestion des registres du BRGM

Explorer À propos Avancé - Rechercher Soumettre

https://data.geoscience.fr/nc/ / \_litho

### Registre: Lithologie

URI: https://data.geoscience.fr/nc/litho

Ce registre contient la classification lithologique du BRGM. Elle définit l'ensemble des matériaux naturels résultant de la combinaison de minéraux, de particules ou d'éléments biogéniques.

```
<?xml version="1.0" encoding="UTF-8" ?>
<rdf:RDF ?xml:lang="fr" ?>
  <rdf:Description ?xml:base="https://data.geoscience.fr/nc/litho/18/" ?>
    <rdf:type ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
      <rdf:Property ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
        <rdf:label ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
          <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
            <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
              <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                  <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                    <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                      <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
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                              <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                                <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
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                                    <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                                      <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
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                                                                                    <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
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                                                                                        <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                                                                                          <rdf:datatype ?xml:base="http://www.w3.org/2001/XMLSchema#" ?>
                                                                                           ...

```

INSPIRE Register Federation

European Commission > INSPIRE > Register Federation > Registries

Registries Registers Relations Federated search Help Login

### Registries

Filter Label	Filter Publisher	Filter URI
<b>Label</b>	<b>Publisher</b>	<b>URI</b>
European Geoscience Registry	BRGM	https://data.geoscience.earth/nc/
Système de publication de registres de l'IDG française	BRGM	http://registre.geocatalogue.fr/registry
INSPIRE registry	European Commission, Joint Research Centre	http://inspire.ec.europa.eu/registry
EEA Data Dictionary vocabularies	European Environment Agency	http://dd.elonet.europa.eu/vocabularies
Austrian INSPIRE registry	CCCA Data Centre	http://registry.inspire.gov.at
INSPIRE Italia Registry	Agency for Digital Italy	http://registry.geodati.gov.it/registry
Lithological Classification Austria - extended values	Geological Survey of Austria	http://resource.geolba.ac.at/lithology/0
Spanish INSPIRE registry	Centro Nacional de Información Geográfica	http://registro.idee.es/registry
BRGM (French geological survey) registry tool	BRGM	https://data.geoscience.fr/nc/
IUGS CGI Geoscience Vocabularies for Linked Data	Geoscience Terminology Working Group (GTWG)	http://resource.geosciml.org/

BRGM THE FRENCH GEOLOGICAL SURVEY



# (3) ? EXPRESSING DATA SEMANTICS DIFFERENTLY ?

## Using web of data oriented semantics

- Feature API support



[About](#) | [Blog](#) | [Download](#)

GeoServer 2.18.x User Manual » Community modules » JSON-LD Extension

[previous](#) | [next](#) | [modules](#)

## JSON-LD Extension

This plugin brings in the ability to output features in a json-ld format, using a json-ld file as a template to operate a second level mapping over such features. [JSON-LD](#) is a Linked Data format, based on JSON format, and revolves around the concept of "context" to provide additional mappings from JSON to an RDF model.

JSON-LD extension works for both simple and complex-features.

- [Installing the GeoServer JSON-LD extension](#)
- [JSON-LD Configuration](#)
- [JSON-LD Output Format](#)
- [JSON-LD Backward Mapping](#)

geopython / pygeoapi

Watch 20 Star 106 Fork 59

<> Code Issues 79 Pull requests 11 Actions Projects 3 Wiki Security 0 Insights

## Add JSON-LD representations #246

Open with

Merged tomkralidis merged 37 commits into geopython:master from spatialdataotearoa:ld-json on 19 Dec 2019

Conversation 36 Commits 37 Checks 0 Files changed 12 +554 -118



alpha-beta-soup commented on 24 Sep 2019

Contributor

This is something I've been considering for a little while. It's great for SEO that pygeoapi includes microdata read from the config in the HTML templates. However I think we could do one better by supporting JSON-LD representations of the API itself, and also extensible GeoJSON-LD representations of actual data.

Reviewers

- tomkralidis
- pvgenuchten
- jorgejesus



## (3) ? EXPRESSING DATA SEMANTICS DIFFERENTLY ?

### Using web of data oriented semantics

- Catalogue API support

#### ISO19139 / Formatter / JSON-LD #3714

**Merged** fxprunayre merged 7 commits into `geonetwork:master` from `fxprunayre:feature/Iso19139/formatter/jsonld` on 11 Jun 2019

Conversation 4   Commits 7   Checks 0   Files changed 6



fxprunayre commented on 29 Mar 2019

Member

Convert an ISO19139 records in JSON-LD format.  
This JSON-LD can be embedded in an HTML page using

```
<html>
  <script type="application/ld+json">
    {json-ld}
  </script>
</html>
```

Based on <https://schema.org/Dataset> and mapping proposed by BRGM team  
<https://github.com/geonetwork/core-geonetwork/wiki/JSON-LD---ISO19139-mapping-proposal>.

Reviewers

pvgenuchten

Assignees

No one assigned

Labels

enhancement

Projects

None yet

- SensorThings API
  - Discussed in SELFIE

### (3) ? EXPRESSING DATA SEMANTICS DIFFERENTLY ?

#### Using web of data oriented semantics

- Linked data client

BRGM Linked Data Viewer

Viewer Examples About

https://opengeospatial.github.io/ELRE/FR/Borehole/gwi/B55000 Launch Add

URI dereferencing  SPARQL Endpoint  
Specify the expected data format

JSON-LD  Turtle  RDF/XML

```
{
  "@sampleOf": "https://sweet.jpl.nasa.gov/2.3/realm/EarthReference.owl#EarthGeosphere",
  "@featureOfInterestOf": [
    {
      "@context": "https://opengeospatial.github.io/ELRE/json-ld/foosa.json-ld",
      "@id": "http://resource.brgm-rec.fr/obs/RawGeologicLogs/B55000DXBD",
      "@type": "Observation",
      "hasFeatureOfInterest": "https://opengeospatial.github.io/ELRE/FR/Borehole/gwi/B55000DXBD",
      "hasResult": [
        {
          "@id": "http://resource.brgm-rec.fr/obs/RawGeologicLogs/B55000DXBD",
          "@type": "GW_GeologyLog"
        }
      ]
    }
  ]
}
```

From JSON-LD

https://opengeospatial.github.io/ELRE/FR/WaterBody/gwi/E6390700

Stabilize graph

Types

- Concept
- none
- Observation
- Sample
- GW\_Well
- Geometry
- Measurement
- Geometry

<https://data.geoscience.fr/Bliv/>

- Benefits

- Data instances not hidden anymore behind the API (as with previous OGC APIs)
  - > data instances can be indexed by search engines
  - > more visibility (data back on the 1<sup>st</sup> line), more reuse of public environmental data/assets



# GENERALISATION

## What a journey !

- Previous era/decade was bringing SDI's to the Web
  - INSPIRE dynamics abide by this (previous OGC APIs, INSPIRE network services guidelines)
- Now SDI's (or environmental IS) are starting to contribute to the web of data
  - Thanks to Linked Data & SemanticWeb
- Note : could have detailed "Metadata" dynamics as well OGC API Record, DCAT
  - But other presentations in that session speak about this
- OGC, INSPIRE related ontologies
  - Generated during (S)ELFIE, being published by OGC-NA
- HTTP URIs on everything
  - Features, codeList entries, APIs, dataset ... to link everything

# CONCLUSION

## Introducing LinkedData and SemanticWeb in Information Systems

- Data providers still provide their data
  - in a way that allows both APIs and data to be discovered and linked to
- > more reuse
- > less loss of time searching for, trying to understand data instead of producing new domain content
- > more domain experts doing their work

Now I have a taste  
of INSPIRE



## LINKS COMPENDIUM

- W3C Best practices
  - 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/>
- QGIS GMLAS Toolbox
  - [https://github.com/BRGM/gml\\_application\\_schema\\_toolbox](https://github.com/BRGM/gml_application_schema_toolbox)
- OGC Linked data Interoperability Experiments
  - ELFIE : <https://opengeospatial.github.io/ELFIE/>
  - SELFIE: <https://github.com/opengeospatial/SELFIE>
- Registry tool - UkGovLd
  - <https://github.com/UKGovLD>
- INSPIRE register federation
  - <https://inspire-regadmin.jrc.ec.europa.eu/ror/>
- GeoServer JSON-LD community plugin
  - <https://docs.geoserver.org/latest/en/user/community/json-ld/index.html>
- PyGeoApi – JSON-LD
  - <https://github.com/geopython/pygeoapi/pull/246>
- Geonetwork – JSON-LD
  - <https://github.com/geonetwork/core-geonetwork/pull/3714>

THANK YOU

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[s.grellet@brgm.fr](mailto:s.grellet@brgm.fr)

