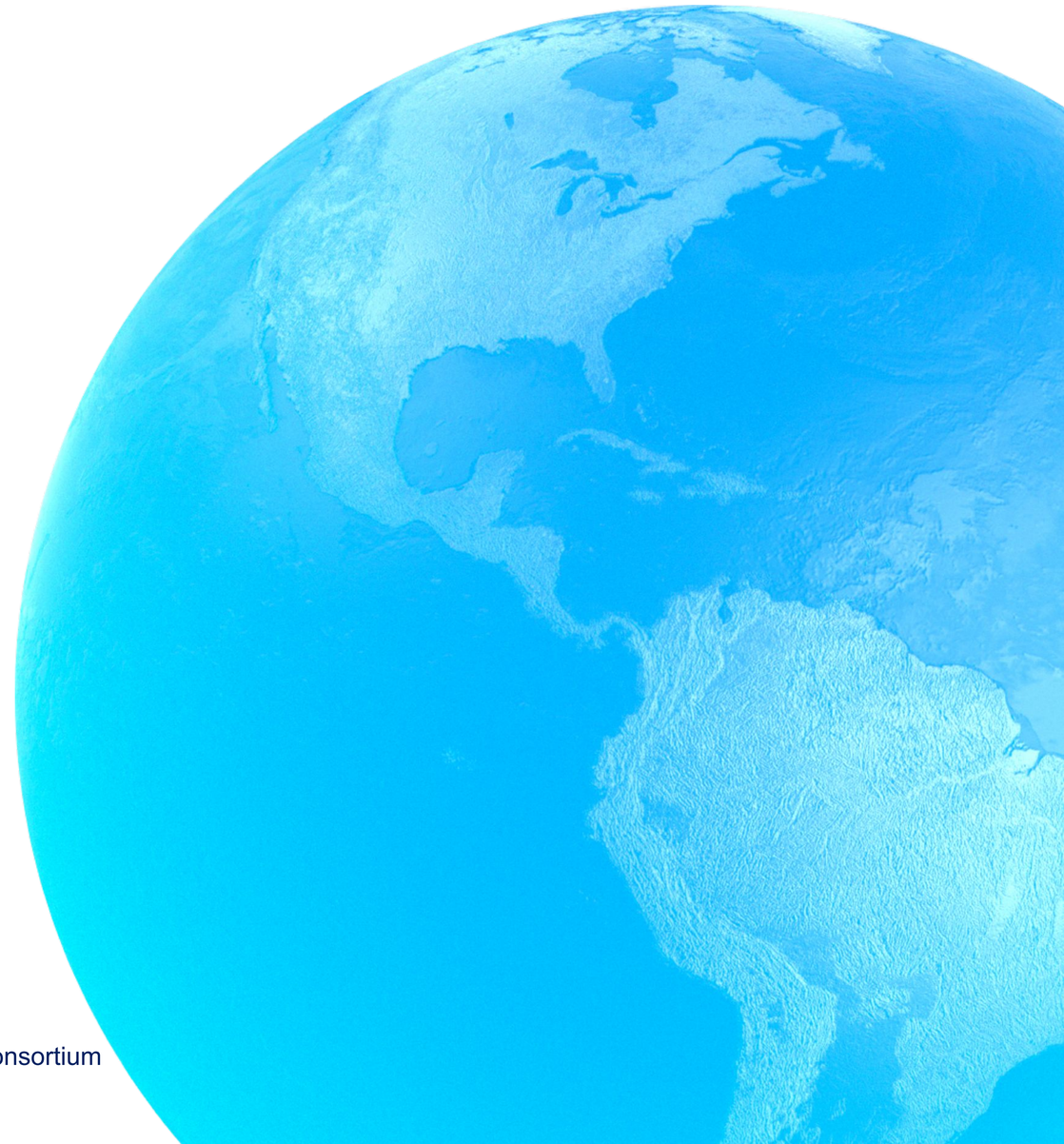
Open Geospatial Consortium

OGC API

Past, Present, and Towards an Exciting Future 🚀



2022-12-28

Workshop Overview

1. Introduction & Background
2. Overview of OGC APIs
3. Related concepts
4. Continuing the journey

About Me

Dr. Joana Simoes
Developer Relations (OGC)

- Data Engineer & Data Scientist.
- PhD in GIS, University College of London.
- +15 years experience in SMEs, academia, a start-up and an international organization (FAO).
- Contributor to FOSS projects.
- OSGeo charter member.

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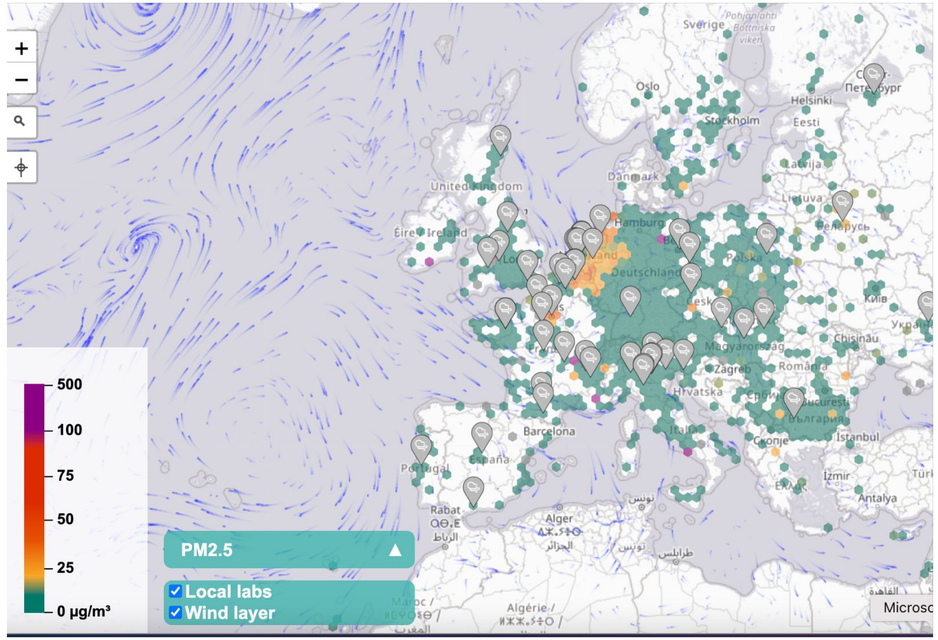
OSGeo

DevRel Collective

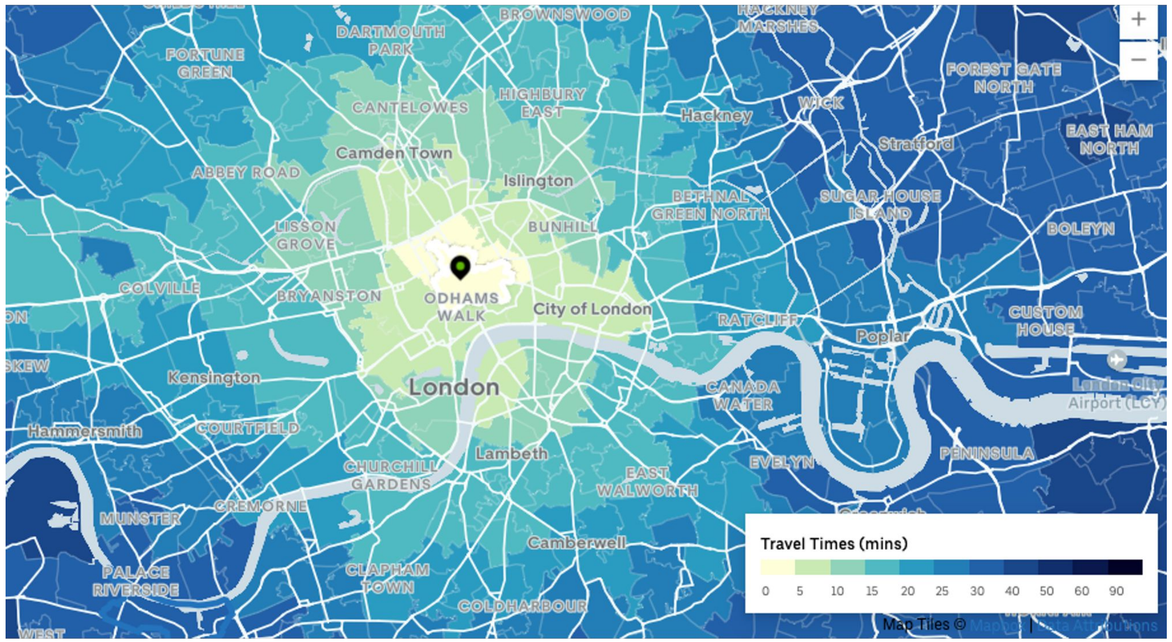
pygeoapi

QGIS

Motivation



Current values of sensors measuring air quality. Source: https://maps.sensor.community/#2/0.0/0.0



Travel times across London. Source: https://movement.uber.com/

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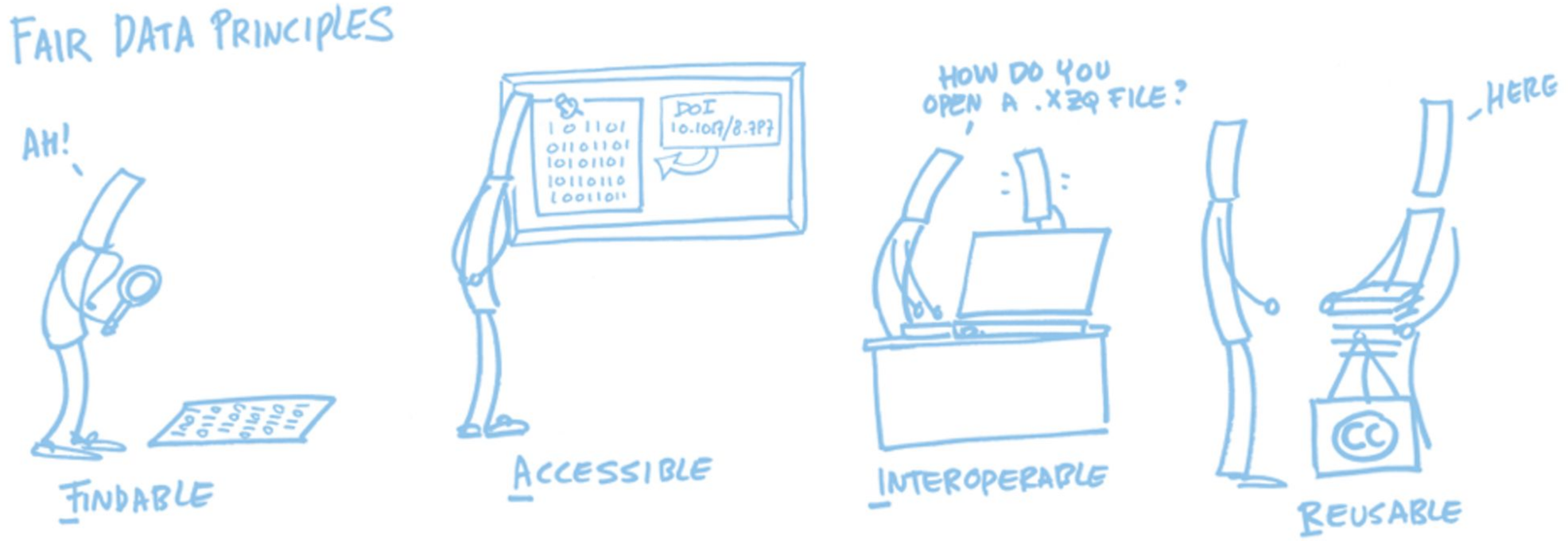
Why using standards for sharing geospatial information?

- To optimise data sharing and reuse by humans and machines.



Source: https://www.openaire.eu/how-to-make-your-data-fair

Some advantages of adopting OGC Standards

- Server side: enable a wide range of clients to consume services (e.g.: no need to create custom clients).
- Client side: being able to consume services from a wide range of servers (e.g.: add support to more sources with minimal coding).
- More data access, less coding.

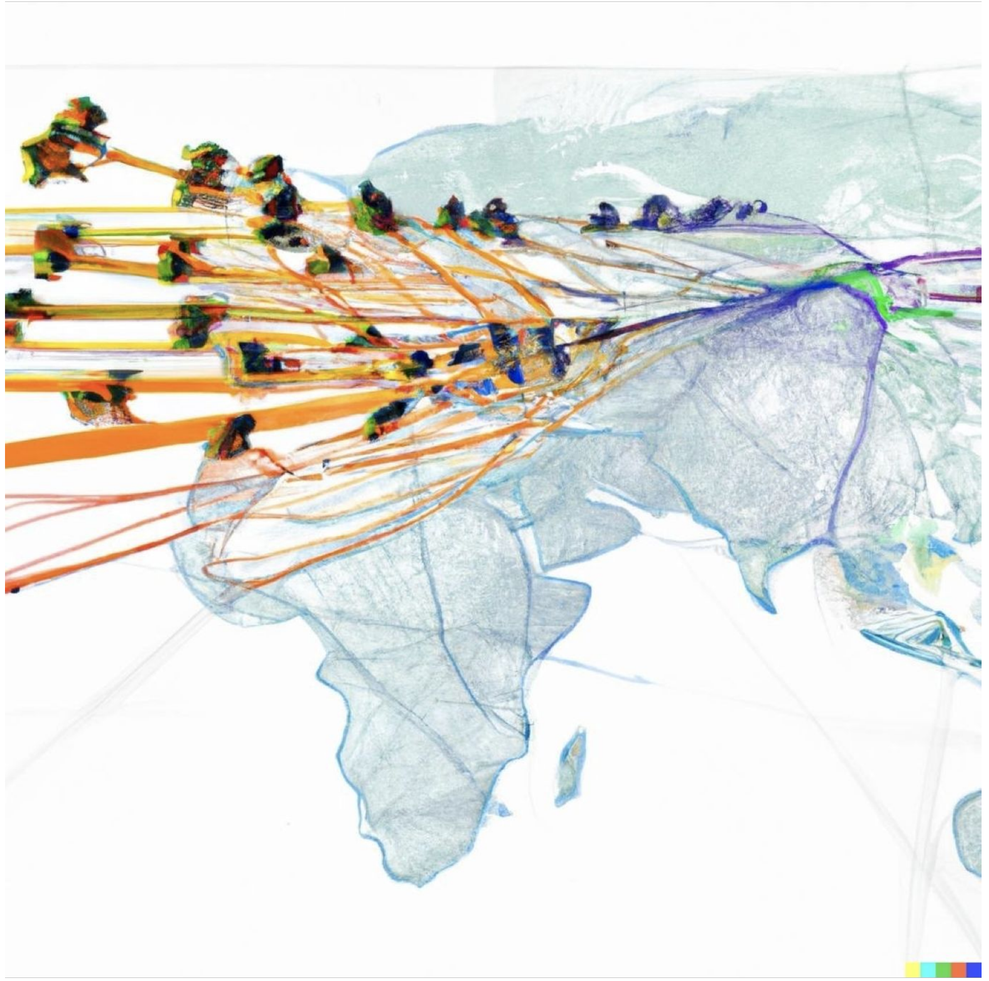


Image generated with DALL.E 2 :https://openai.com/dall-e-2/

What is an OGC Standard?

- A document, established by consensus and approved by the OGC Membership, that provides rules and guidelines, aimed at the optimum degree of interoperability in a given context.

Photo taken March 2018

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What's in an OGC Standard?

Specification Elements

- Requirements Classes
- Requirements
- Conformance Classes
- Conformance Tests

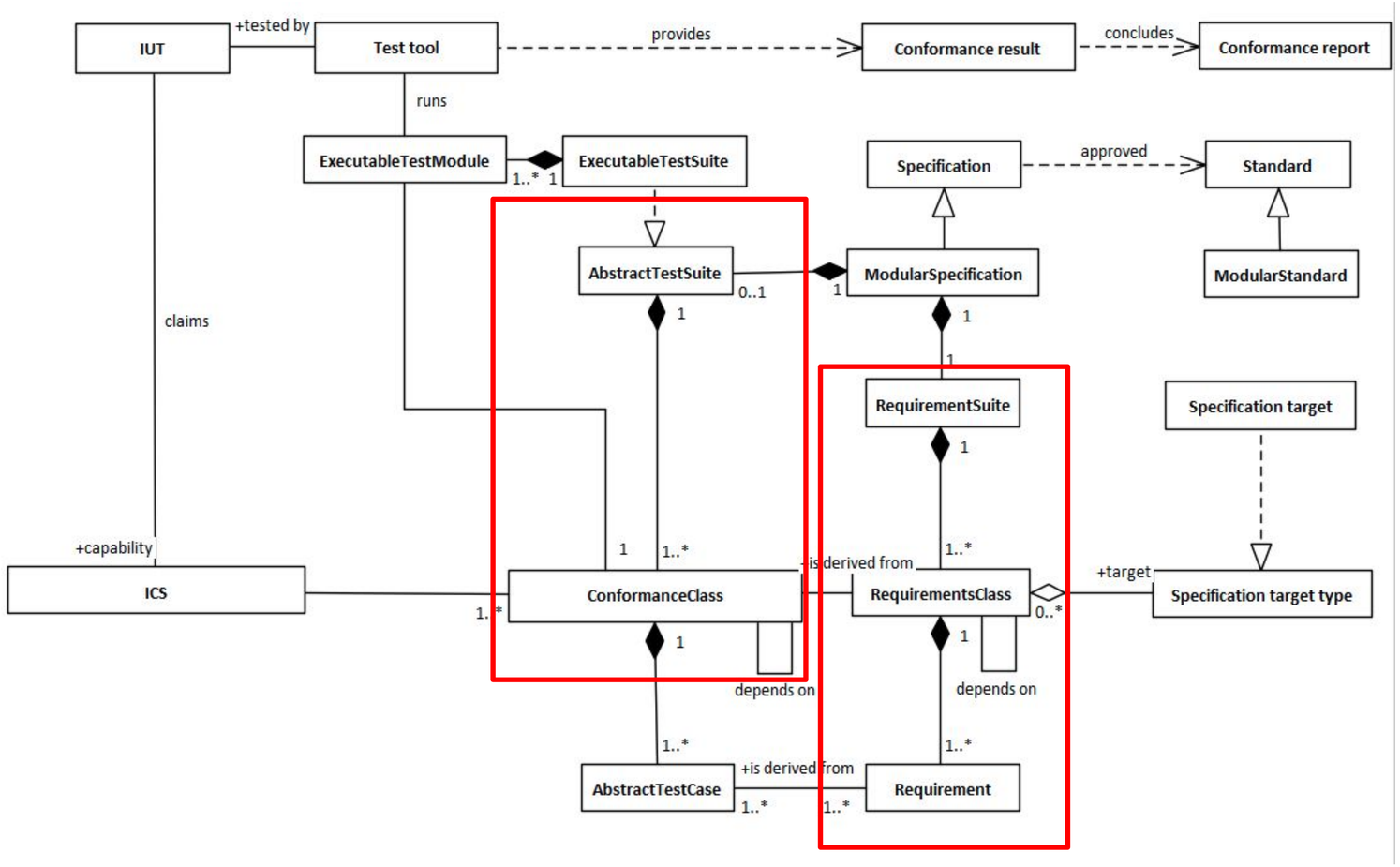

Image source: ISO 19105

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Example Specification Elements

Taken from OGC API – Features – Part 1: Core

Requirement 10	**/req/core/crs84**
A	Unless the client explicitly requests a different coordinate reference system, all spatial geometries SHALL be in the coordinate reference system http://www.opengis.net/def/crs/OGC/1.3/CRS84 (WGS 84 longitude/latitude) for geometries without height information and http://www.opengis.net/def/crs/OGC/0/CRS84h (WGS 84 longitude/latitude plus ellipsoidal height) for geometries with height information.

Abstract Test 2	**/ats/core/crs84**
Test Purpose	Validate that all spatial geometries provided through the API are in the CRS84 spatial reference system unless otherwise requested by the client.
Requirement	/req/core/crs84
Test Method	1. Do not specify a coordinate reference system in any request. All spatial data should be in the CRS84 reference system. 2. Validate retrieved spatial data using the CRS84 reference system.

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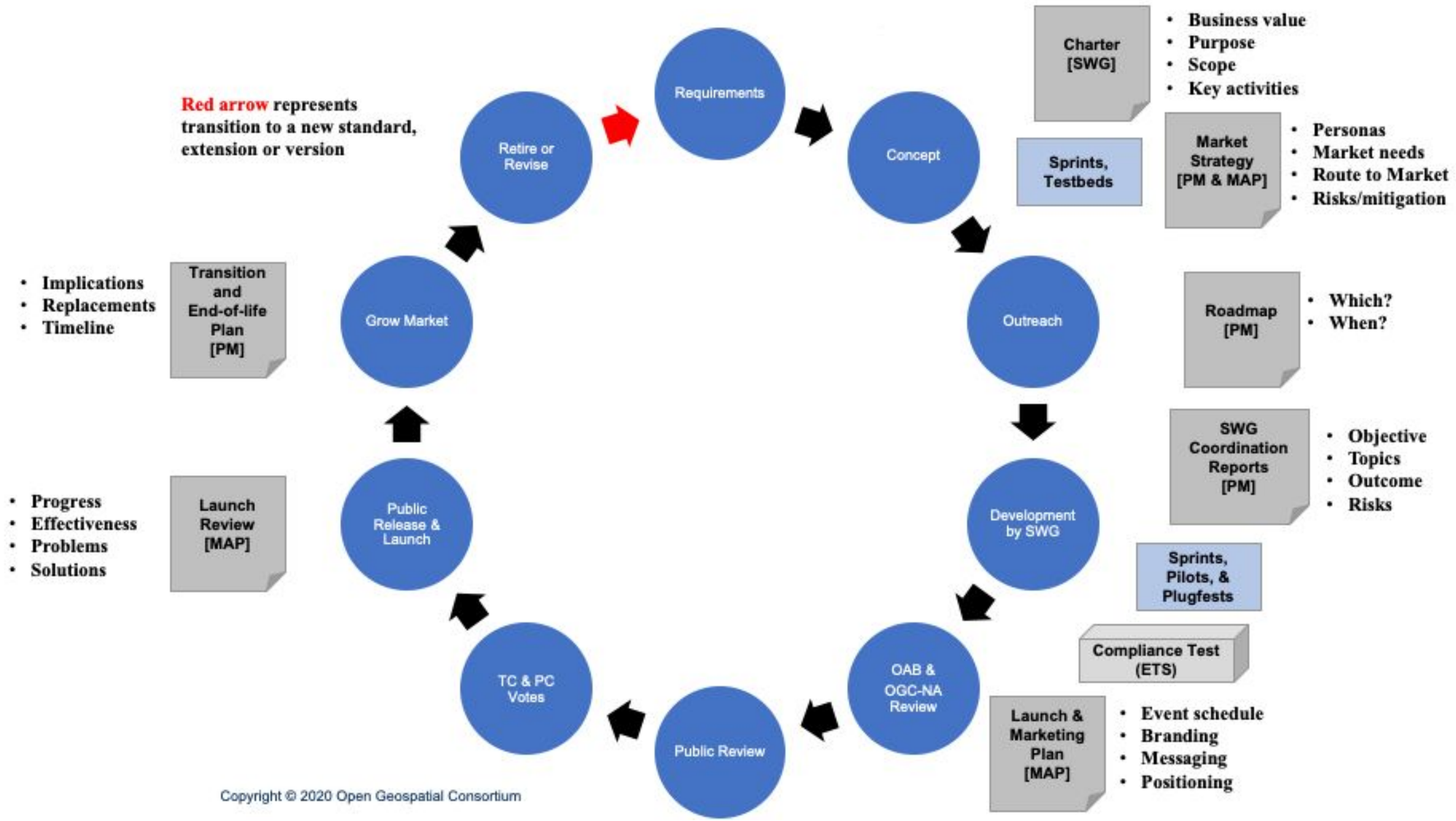
OGC Product Lifecycle



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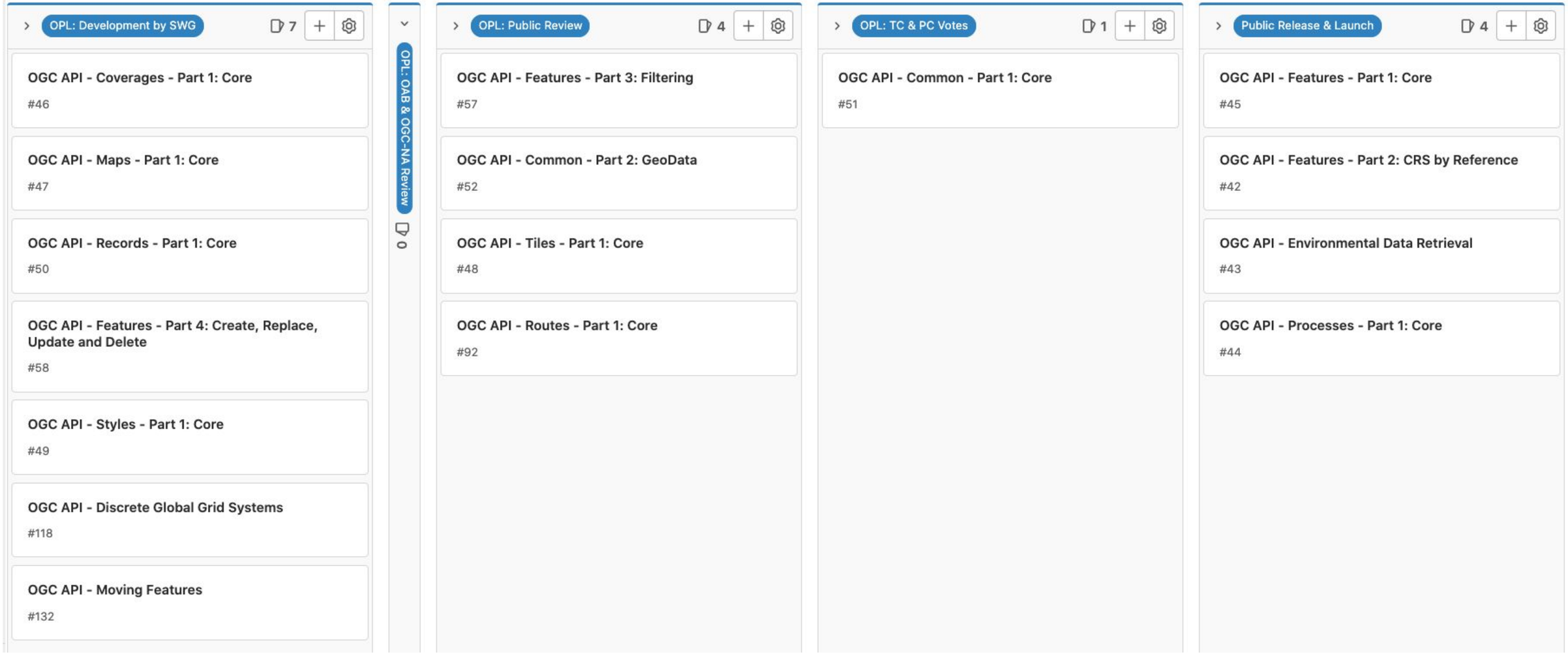
Stage in the Lifecycle



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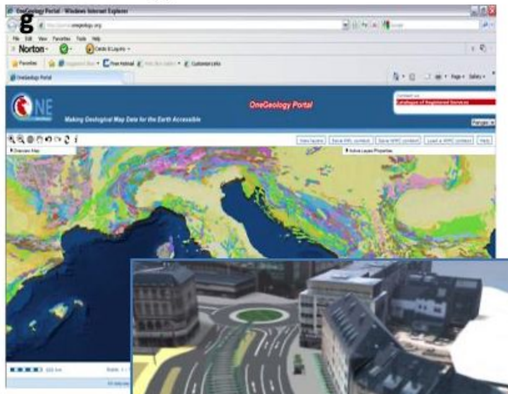
Millions of Geospatial Datasets on >200K Servers

OneGeology.Or



Emergency / Disaster Management

OGC Web Services (OWS)

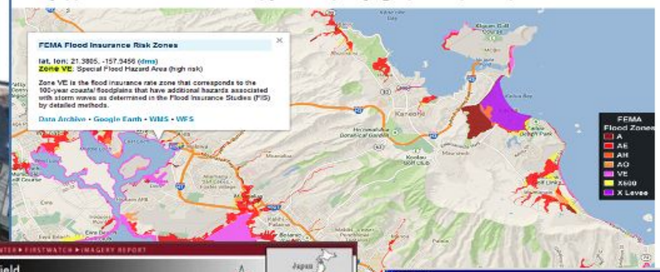
Web Map Service (WMS)

Web Map Tile Service (WMTS)

Web Feature Service (WFS)

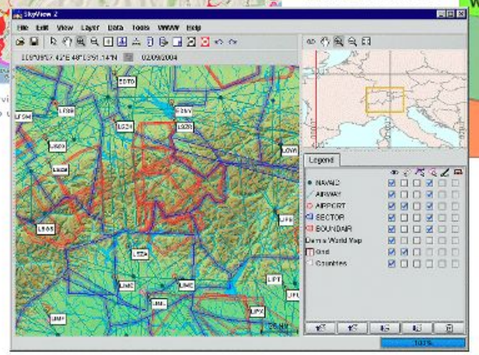
Web Coverage Service (WCS)

http://oos.soest.hawaii.edu/pacioos/voyager/news/2013/



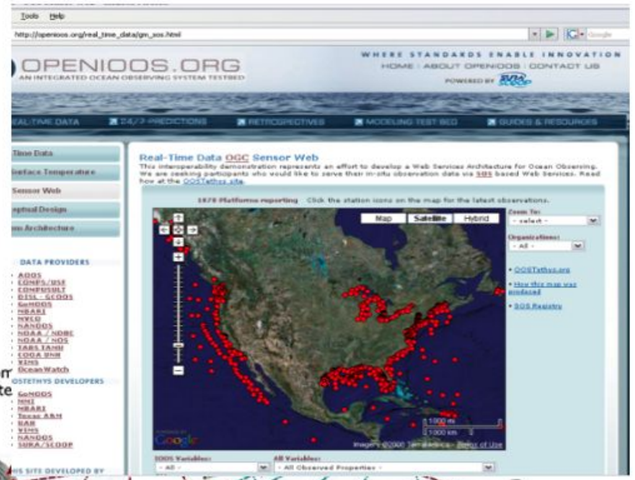
DigitalGlobe

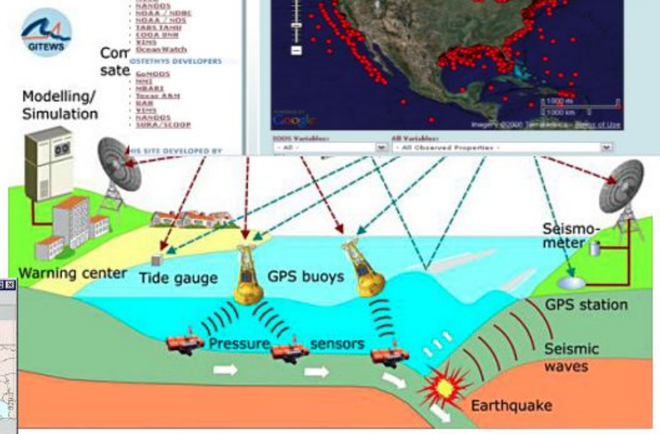
Eurocontrol



Aviation Flight Information / Safety

OpenIOOS.Org





Meteorology, Hydrology, Ocean Monitoring

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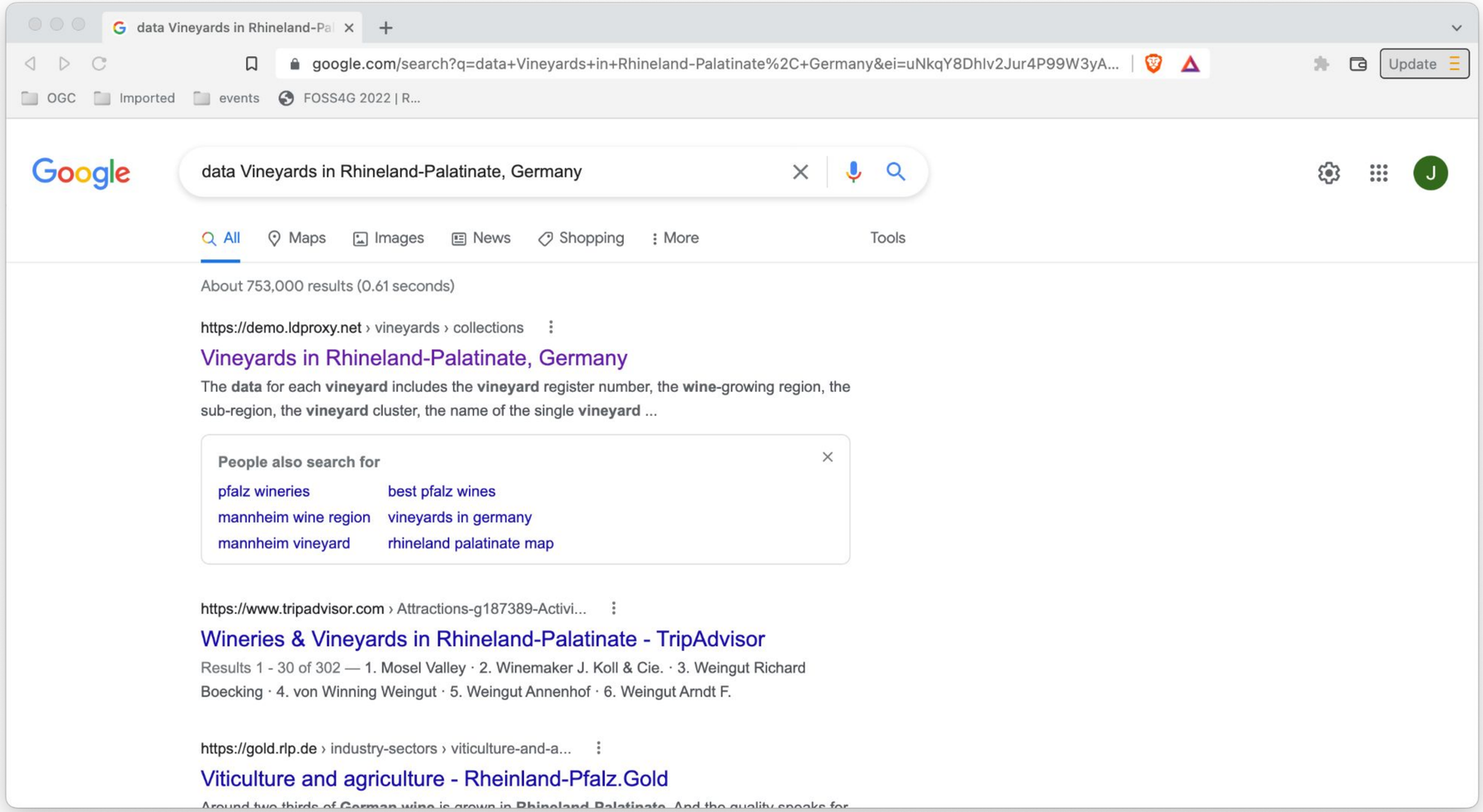
Background: Legacy OGC Web Services (OWS)

	WMS	WFS	WCS	WPS	SOS	SPS	CSW	WMTS
Use HTTP methods explicitly.	Y	N	Y*	N	N	N	N	Y
Be stateless.	Y	Y	Y	Y	Y	Y	Y	Y
Expose directory structure-like URIs.	N	N	N	N	N	N	N	Y
Use HTTP Error codes	N	N	N	N	N	N	N	N
Transfer XML, JavaScript Object Notation (JSON), or image.	Image	XML	Any	Any	XML	XML	XML	Image

Source: OGC 15-052r1r1

What do users expect now?



What do users expect now?

1. Enter search criteria for the data using a browser and search engine
2. Browse through the first results and check, if one of them seems to provide the desired data or refers to it
3. Browse through the data to determine, if it really has the information you are looking for, is available in a format that you can handle and that is has a license that suits your needs
4. Download the dataset or study the online API documentation and examples for accessing the data
5. Use the data/API in your application

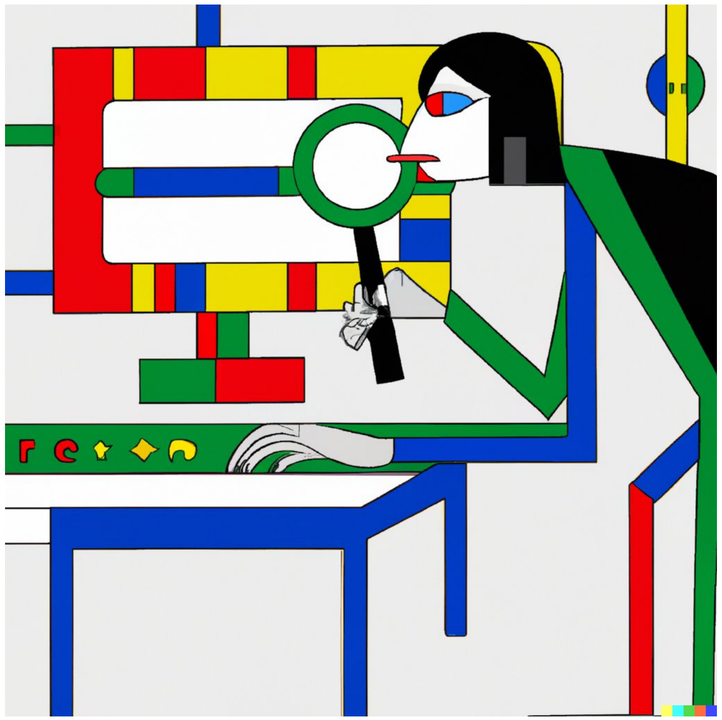


Image generated with DALL.E 2 :https://openai.com/dall-e-2/

Follow the rules of the Web architecture

- Web browsers
- HTTP / HTTPS
- Web linking
- Delegation to applications via media types
- Search engines
- Schema.org, OpenAPI and other generally understood metadata

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

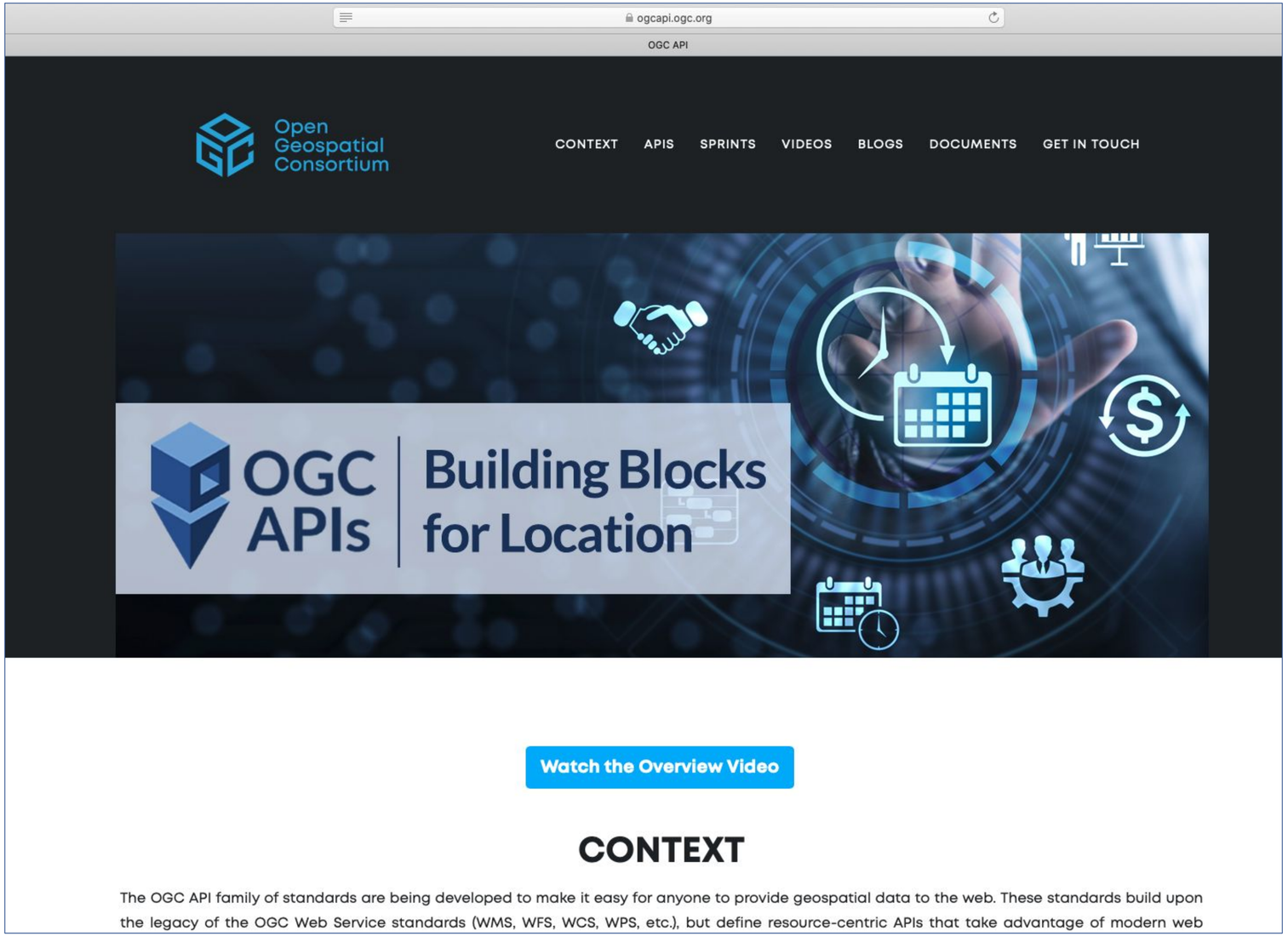
Modern Web APIs

APIs are a popular, effective method for rapid software development.

There is an increasing need for interoperability between Web APIs.

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

ogcapi.ogc.org



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OGC APIs

Built on modern web development practices

- Resource oriented architecture.
- http methods, status codes, errors.
- Content negotiation.
- Recommended encodings: JSON, HTML.
- schema.org annotations.

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Improved Developer Experience

Quicker onboarding for non OGC/GIS experts.

W3C/OGC Spatial Data on the Web Best Practices

W3C Working Group Note

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Spatial Data on the Web Best Practices

OGC® Making location count. W3C

W3C Working Group Note 28 September 2017

This version:
https://www.w3.org/TR/2017/NOTE-sdw-bp-20170928/

Latest published version:
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Latest editor's draft:
https://w3c.github.io/sdw/bp/

Previous version:
https://www.w3.org/TR/2017/NOTE-sdw-bp-20170511/

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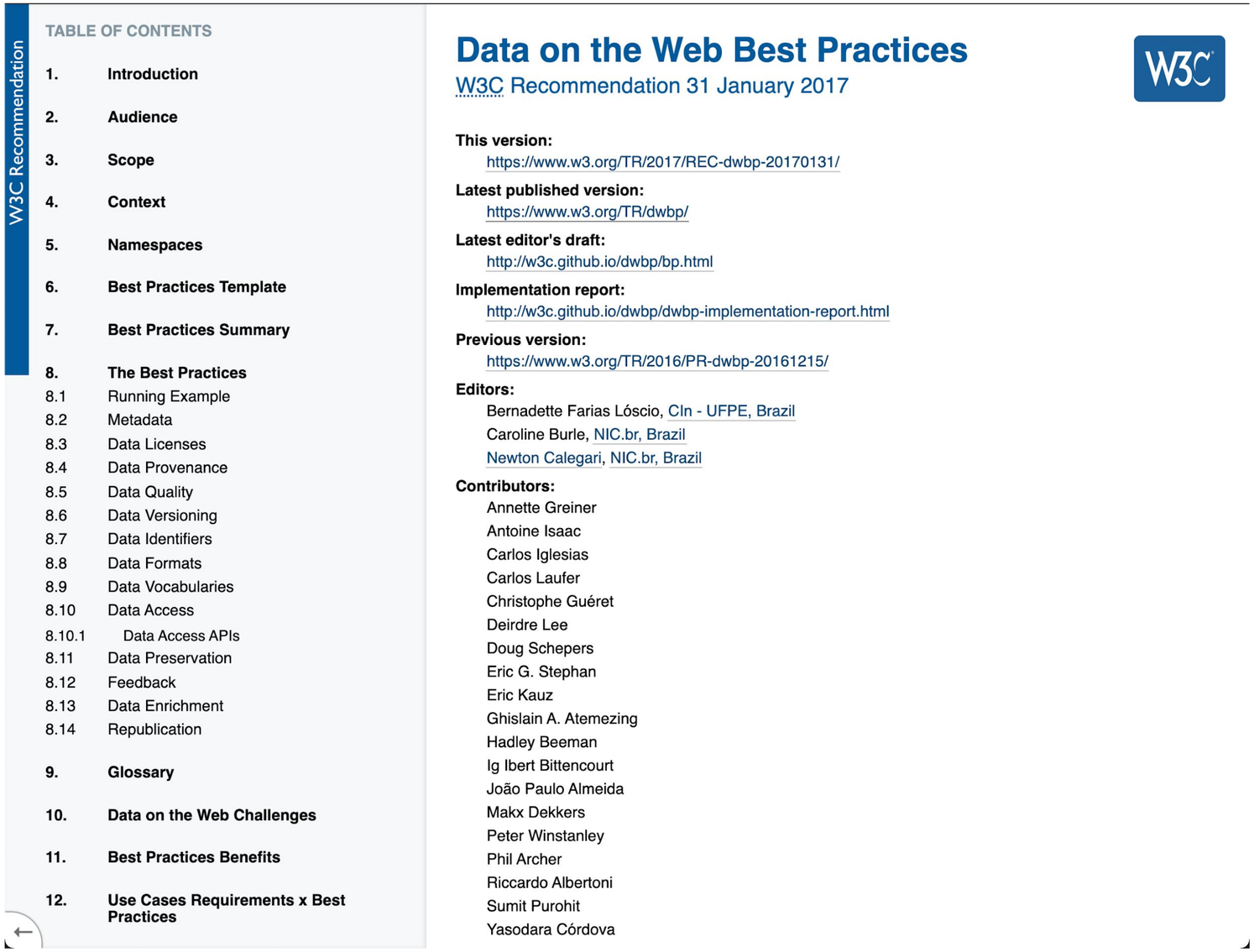
OGC Document Number:
OGC 15-107

W3C Data on the Web Best Practices



W3C Recommendation

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Data on the Web Best Practices

W3C Recommendation 31 January 2017

This version:
https://www.w3.org/TR/2017/REC-dwbp-20170131/

Latest published version:
https://www.w3.org/TR/dwbp/

Latest editor's draft:
http://w3c.github.io/dwbp/bp.html

Implementation report:
http://w3c.github.io/dwbp/dwbp-implementation-report.html

Previous version:
https://www.w3.org/TR/2016/PR-dwbp-20161215/

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OGC White Paper on Open Geospatial APIs

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OGC Document 16-019r4

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URL for this OGC® document: http://docs.opengeospatial.org/wp/16-019r4/16-019r4.html
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Submission Date: 2016-11-16

OGC® Open Geospatial APIs - White Paper

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Document type: OGC® White Paper
Document stage: Approved for Public Release
Document language: English

Preface

OGC defines interfaces that enable interoperability of geospatial applications. API's are a popular method to implement interfaces for accessing spatial data. This White Paper provides a discussion of Application Programming Interfaces (APIs) to support discussion of possible actions in the Open Geospatial Consortium (OGC).

Annexes are provided on these topics:

The main themes of paper are:

- **APIs are popular** because they are an effective method for rapid software development in particular for distributed systems. Examples of successful geospatial mapping APIs are listed in Annex A: Google Maps, OpenLayers, MapQuest API for OpenStreetMap, Leaflet, Esri ArcGIS REST and Mapbox
- The proliferation of **API variations degrade interoperability** defined by web protocols. The examples in Annex A show such variations in several parameters including "Zoom" level. A summary of the differences of Zoom is provided in Chapter 2, Table 1 - Comparison of Map-related attributes from several APIs.
- **Protocols provide interoperability** when implemented consistently across APIs. The OGC WMTS protocol when implemented across multiple APIs enables interoperability as demonstrated in the Figure at the end of Chapter 2. By using consistently using the WMTS TileMatrixSet, graphics returned from several APIs can provide a consistent, composite map. Similarly **consistent use of OGC Essentials** will improve interoperability (See Chapter 4).
- API implementation experience should be used to **improve the OGC Web Service Protocols**. Several RESTful approaches for defining OWS protocols based on resource types are being considered in OGC. Further, this white paper recommends that OGC consider activities that provide for consistent implementation of OWS protocols across multiple APIs (See in particular Chapters 3 and 4).

OpenAPI (f.k.a. Swagger)

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OpenAPI Specification

Version 3.0.3

Published 20 February 2020

Latest editor's draft:
https://github.com/OAI/OpenAPI-Specification/

Editors:
Darrel Miller
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Marsh Gardiner
Mike Ralphson
Ron Ratovsky
Uri Sarid

Former editors:
Jason Harmon
Tony Tam

Participate:
GitHub OAI/OpenAPI-Specification
File a bug
Commit history
Pull requests

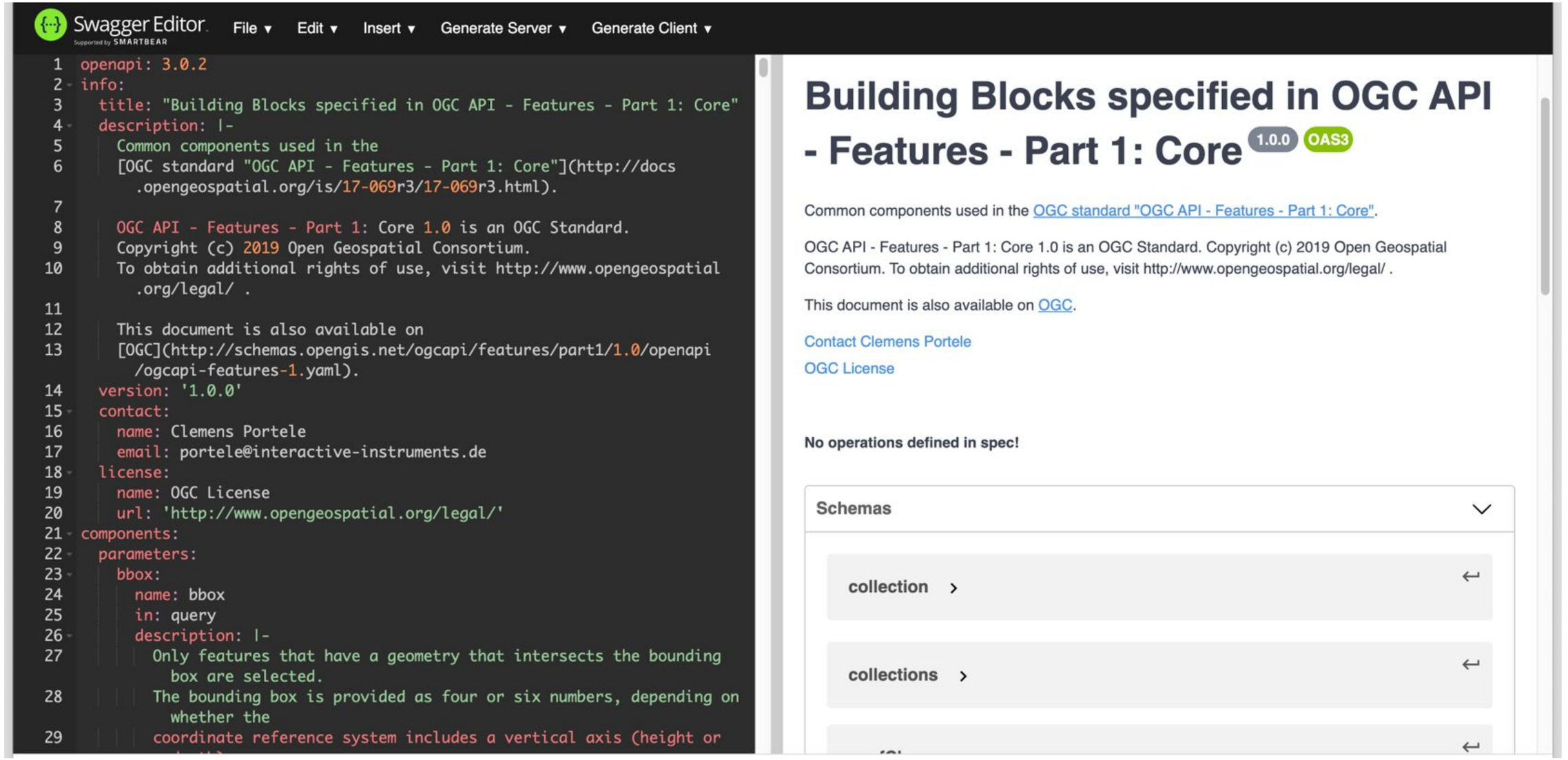
Abstract

The OpenAPI Specification (OAS) defines a standard, programming language-agnostic interface description for REST APIs, which allows both humans and computers to discover and understand the capabilities of a service without requiring access to source code, additional documentation, or inspection of network traffic. When properly defined via OpenAPI, a consumer can understand and interact with the remote service with a minimal amount of implementation logic. Similar to what interface descriptions have done for lower-level programming, the OpenAPI Specification removes guesswork in calling a service.

Status of This Document

The source-of-truth for the specification is the GitHub markdown file referenced above.

All defined in OpenAPI



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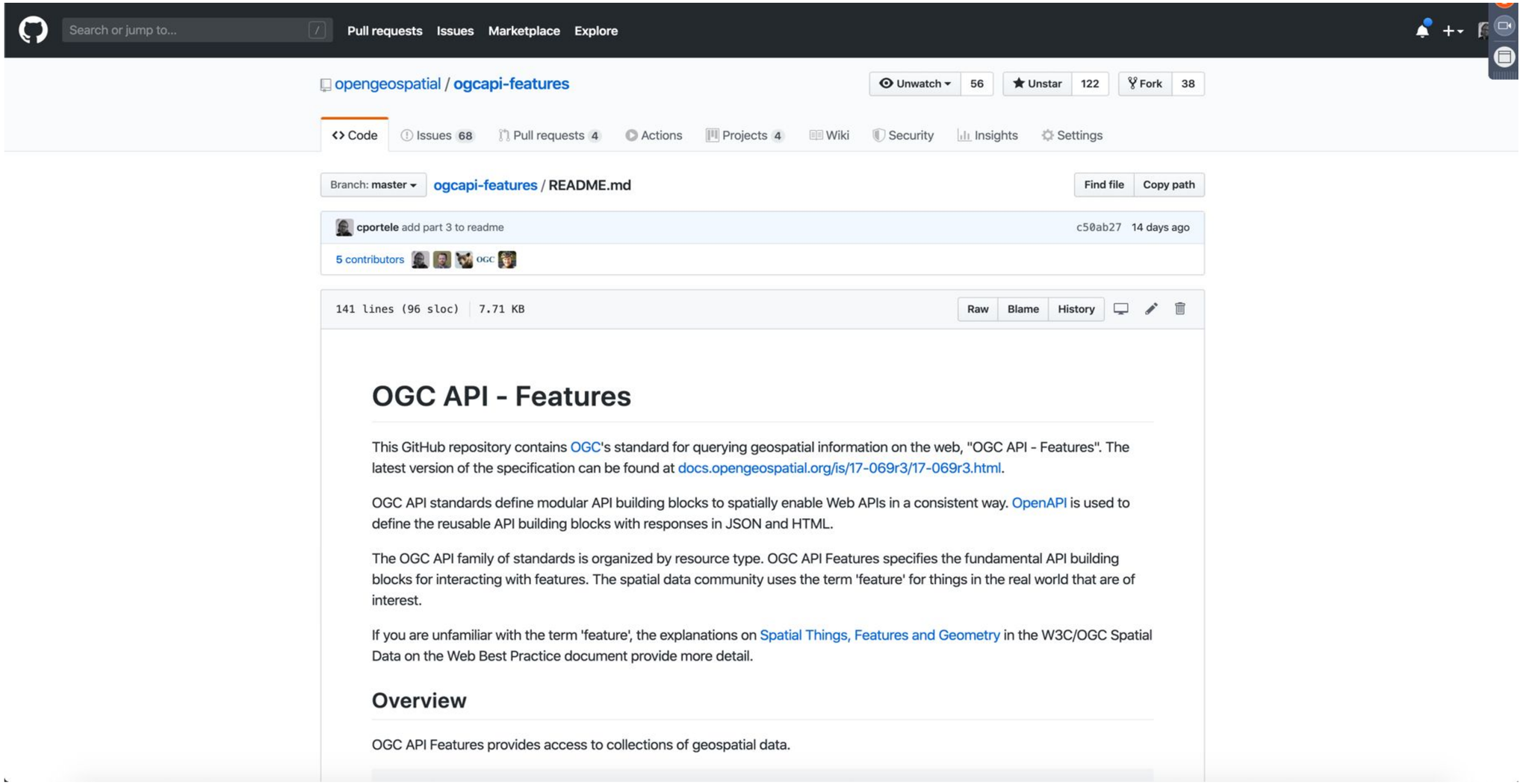
Everything is on GitHub, including the discussions



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Approved and Candidate OGC API Standards

OGC API – Discrete Global Grid Systems

OGC API – Records

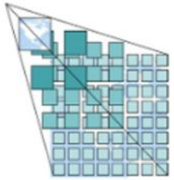
OGC API - Maps

OGC API - Styles

Sensor Things API

OGC API – Moving Features

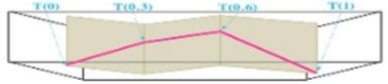
OGC API - Tiles



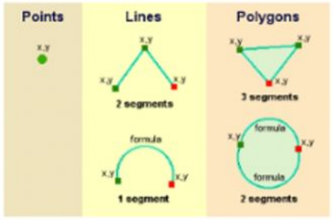
OGC API - Common

OGC API - Routes

OGC API – Environmental Data Retrieval



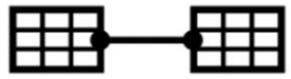
OGC API - Features



OGC API - Processes

OGC API – Coverages

OGC API – Joins



Green border means **approved**

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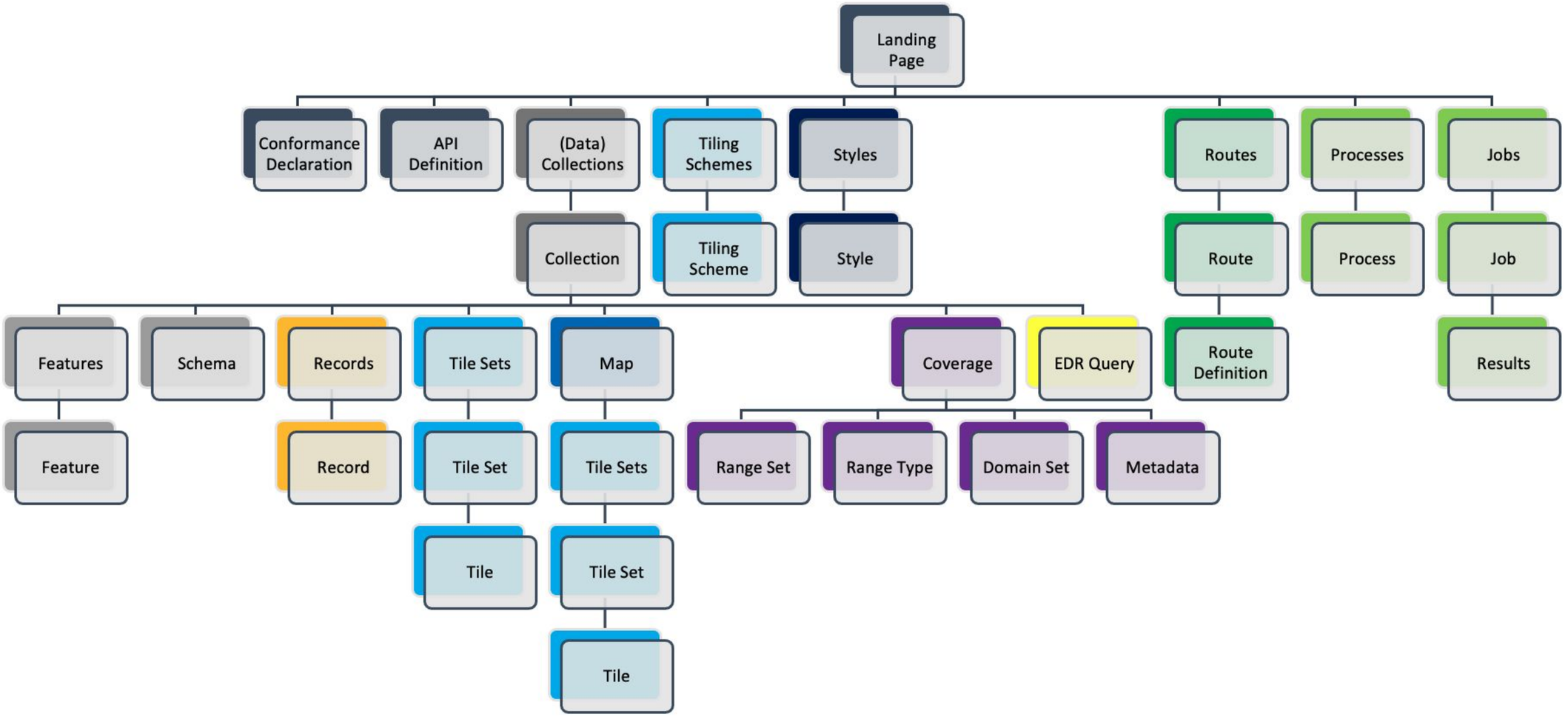
Resources in OGC API Standards



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OGC API Overview

- OGC API - EDR
- OGC API - Processes
- OGC API - Coverages
- OGC API - Joins
- OGC API - Records

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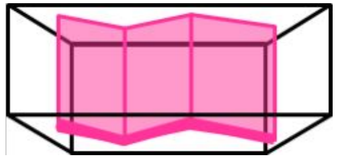
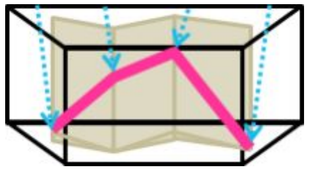
OGC API - EDR

APPROVED

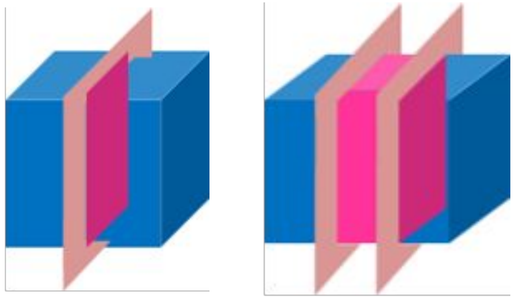
- Provides interfaces to access environmental data resources.
- An EDR collection can contain virtually any data about the natural or built environment that needs to be sampled using a spatio-temporal query pattern.



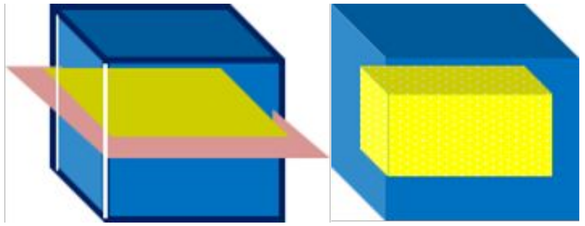
Information from a hydrologic sensor might be found spatially or accessed by ID.



Geospatial gridded data such as a digital elevation model might be accessed along a transect.



A climate model or weather reanalysis might be accessed at a point or within a bounding rectangle



Weather information from meteorological stations might be queried within a specified polygon.

Overview of OGC API - EDR

Resource	Path	HTTP method
Landing page	/	GET
Conformance declaration	/conformance	GET
Description of the collections of spatio-temporal data available from this API.	/collections	GET
Identifies a collection of spatio-temporal data with the unique identifier {collectionId}	/collections/{collectionId}	GET
Identifies an Information Resource of type {queryType} associated with the {collectionId} collection.	/collections/{collectionId}/{queryType}	GET

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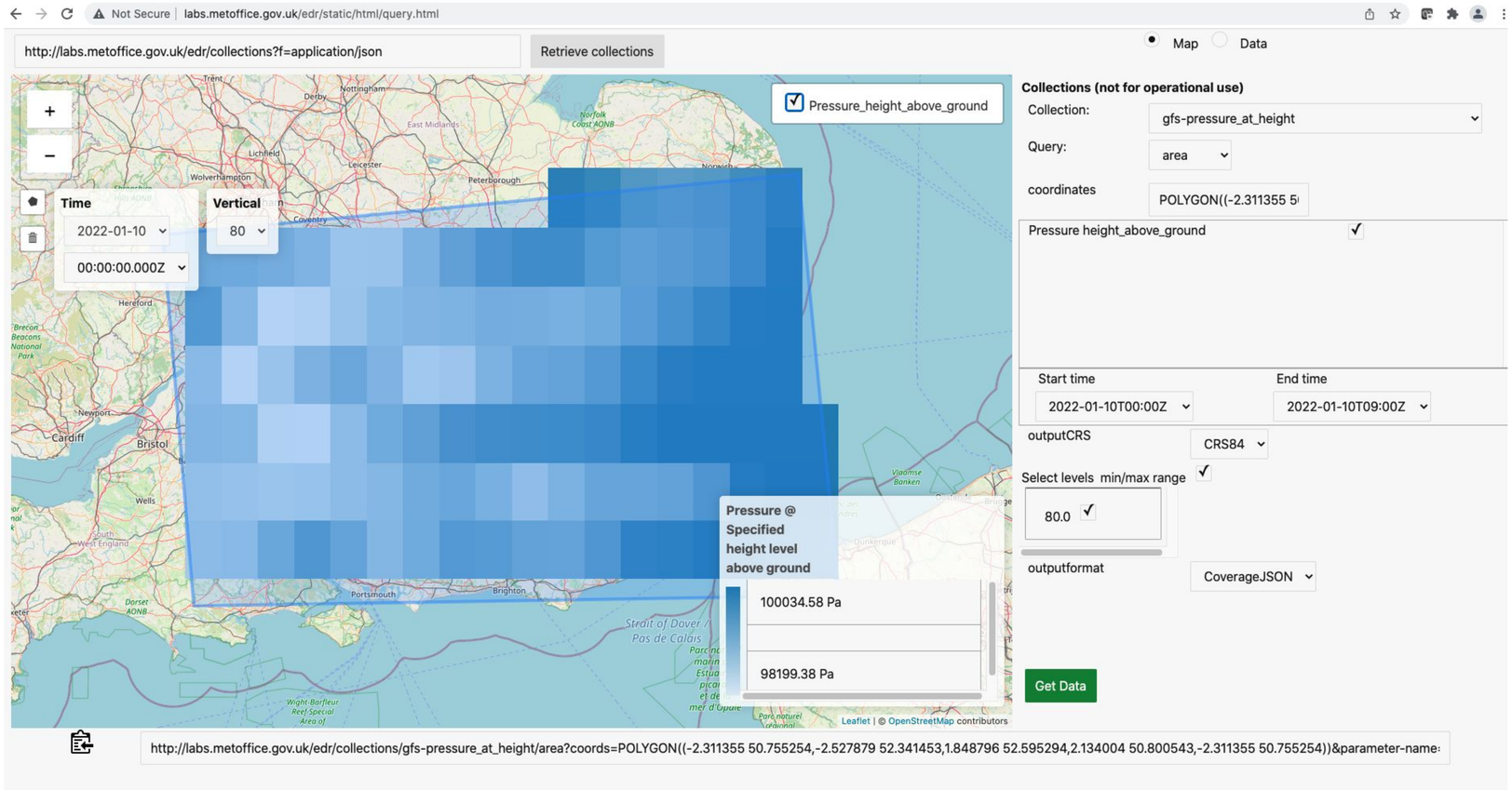
Example Case Study: OGC API – EDR

UK Met Office demo client



http://labs.metoffice.gov.uk/edr/static/html/query.html

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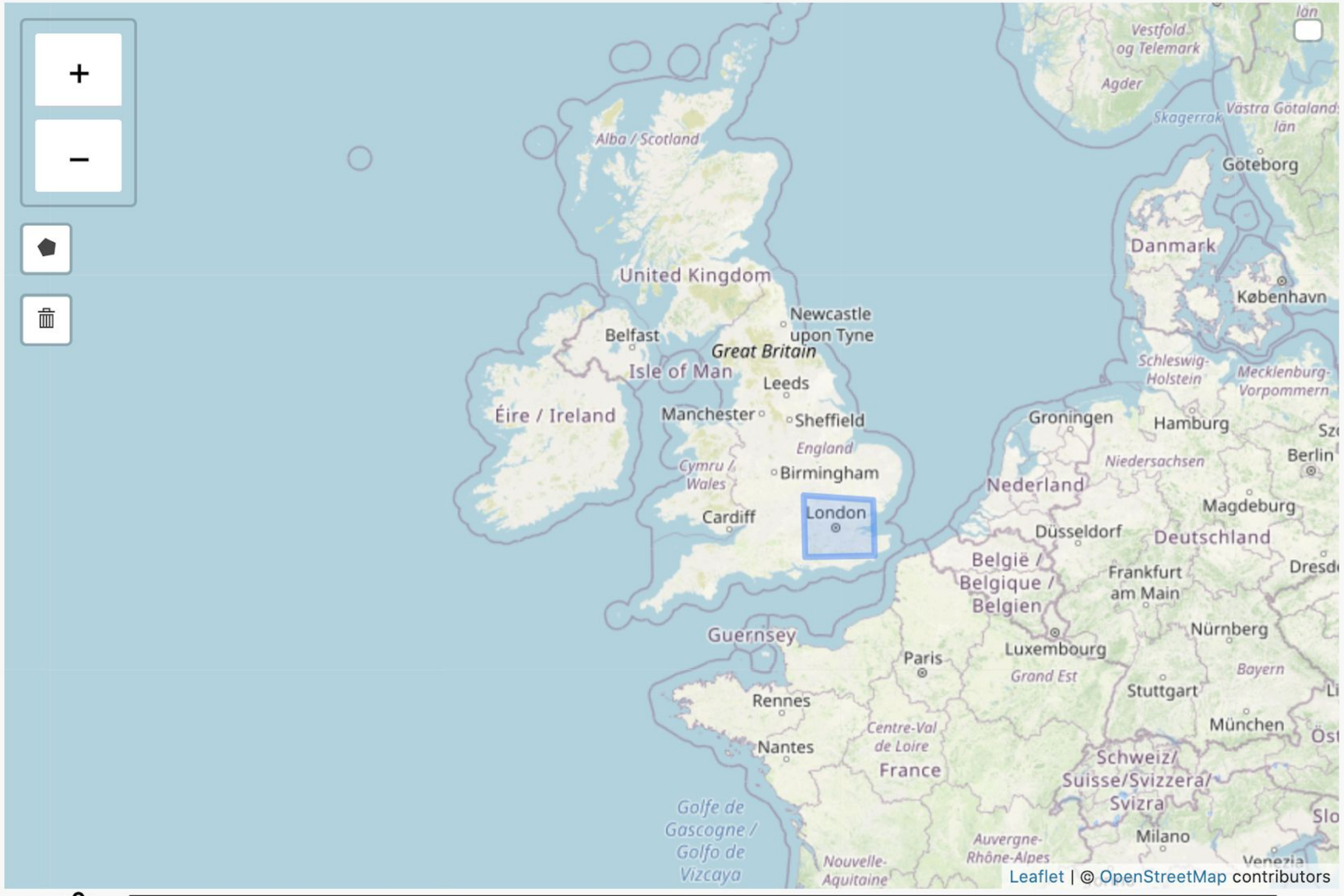
Not Secure | labs.metoffice.gov.uk/edr/static/html/query.html

http://labs.metoffice.gov.uk/edr/collections?f=application/json

Retrieve collections

Map Data



Collections (demo not for operational use)

Collection: gfs-wind_at_height_above_ground

Query: area

Coordinates: POLYGON((-1.018 50.990,-1.068 52.0

u-component of_wind_height_above_ground ☐

v-component of_wind_height_above_ground ☑

Start time: 2022-05-16T18:00Z

End time: 2022-05-17T00:00Z

outputCRS: EPSG:4326

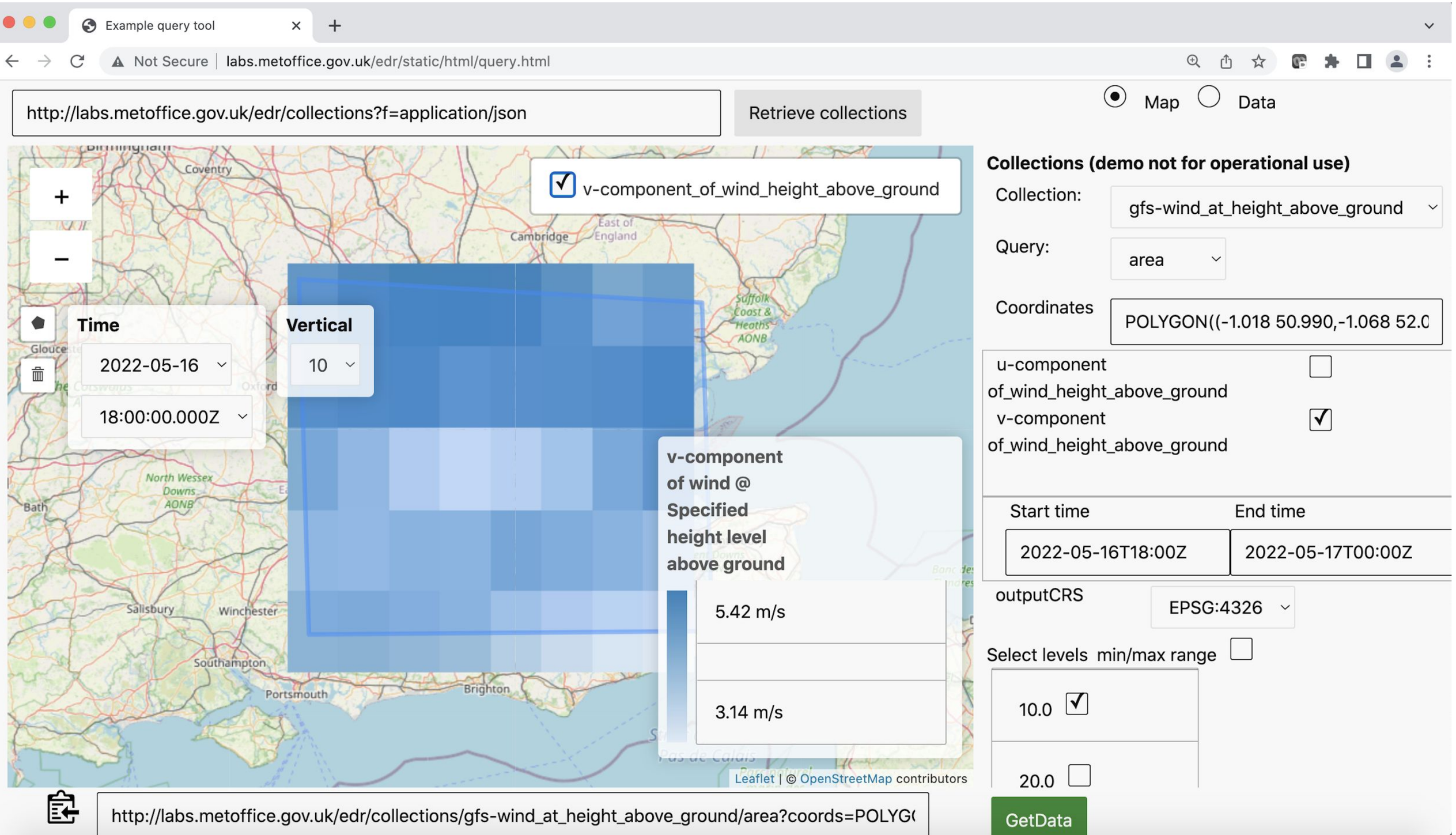
Select levels min/max range ☐

10.0 ☑

20.0 ☐

http://labs.metoffice.gov.uk/edr/collections/copernicus_dem/area?coords=POLYGON((-7.112 49.941

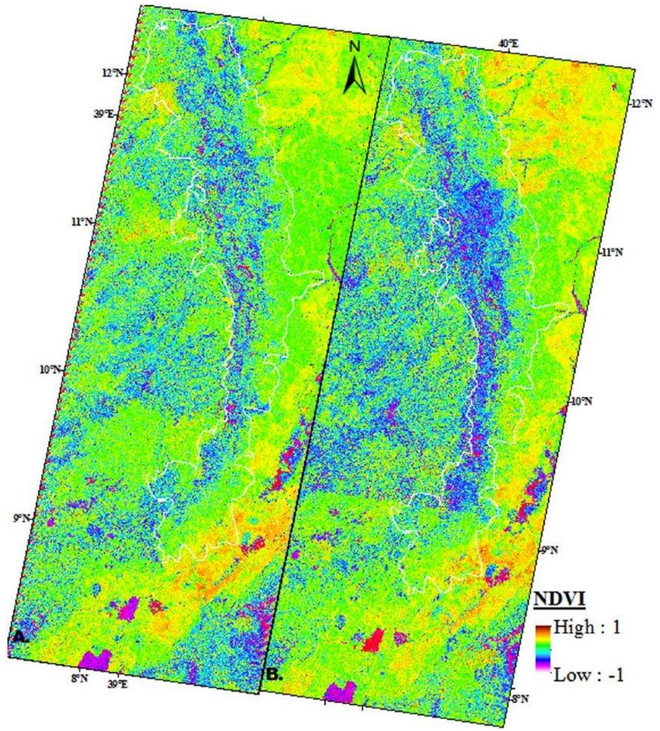
GetData


Example query tool
Not Secure
labs.metoffice.gov.uk/edr/static/html/query.html
http://labs.metoffice.gov.uk/edr/collections?f=application/json
Retrieve collections
Map
Data
v-component_of_wind_height_above_ground
Time
2022-05-16
18:00:00.000Z
Vertical
10
v-component of wind @ Specified height level above ground
5.42 m/s
3.14 m/s
Leaflet | © OpenStreetMap contributors
Collections (demo not for operational use)
Collection:
gfs-wind_at_height_above_ground
Query:
area
Coordinates
POLYGON((-1.018 50.990,-1.068 52.0
u-component of_wind_height_above_ground
v-component of_wind_height_above_ground
Start time
End time
2022-05-16T18:00Z
2022-05-17T00:00Z
outputCRS
EPSG:4326
Select levels min/max range
10.0
20.0
http://labs.metoffice.gov.uk/edr/collections/gfs-wind_at_height_above_ground/area?coords=POLYG(
GetData

OGC API - Processes

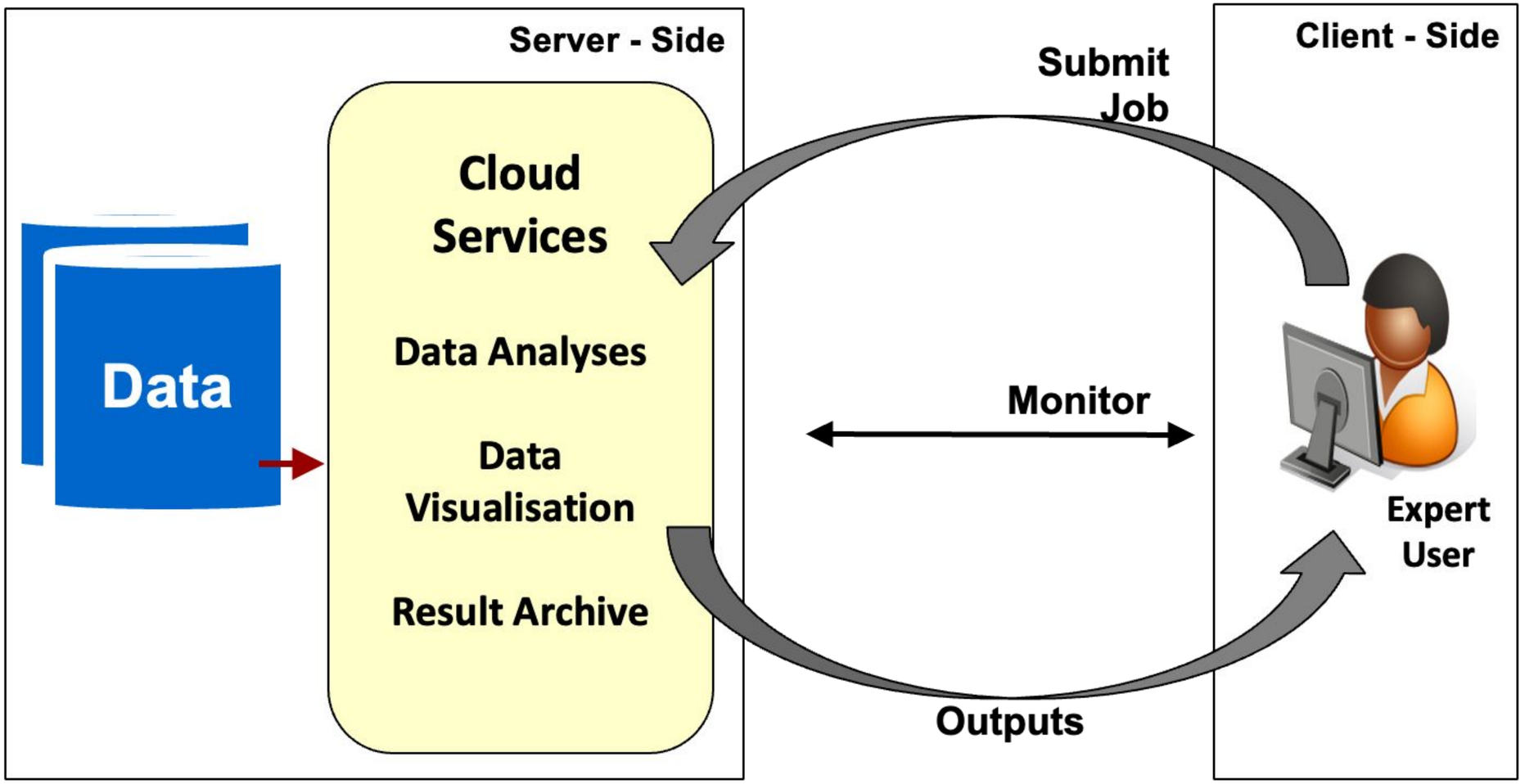
APPROVED

- Supports the wrapping of computational tasks into executable processes.
- Processes can be offered by a server through a Web API and be invoked by a client application.
- Processes include well-defined algorithms that ingest vector and/or coverage data to produce new datasets.



Ayele, Gebiaw & Tebeje, Aschalew Kassie & Demissie, Solomon & Belete, Mulugeta & Jemberie, Mengistu & Teshome, Wondie & Mengistu, Dereje & Teshale, Engidasew. (2018). Time Series Land Cover Mapping and Change Detection Analysis Using Geographic Information System and Remote Sensing, Northern Ethiopia. Air, Soil and Water Research. 11. 117862211775160. 10.1177/1178622117751603.

OGC API - Processes Workflow



high performance environment

low internet bandwidth

Overview of OGC API - Processes

Resource	Path	HTTP method
Landing page	/	GET
Conformance declaration	/conformance	GET
Process list	/processes	GET
Process description	/processes/{processID}	GET
Process execution	/processes/{processID}/execution	POST
Job status info	/jobs/{jobID}	GET
Job results	/jobs/{jobID}/results	GET
Job list	/jobs	GET
Job status info	/jobs/{jobID}	DELETE

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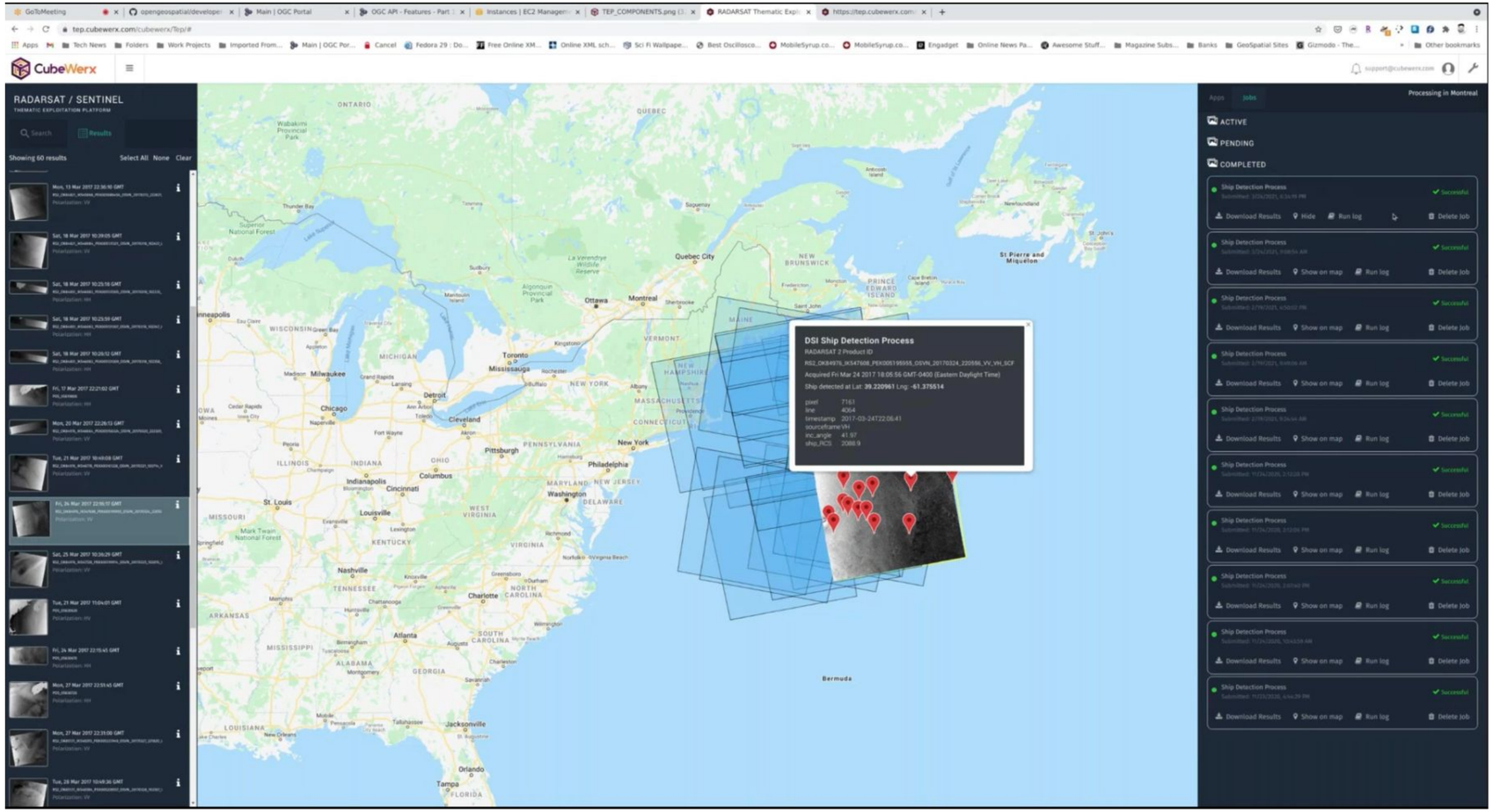
Example Case Study: OGC API - Processes

Analytical processing of RADARSAT satellite imagery



https://www.cubewerx.com/analytics

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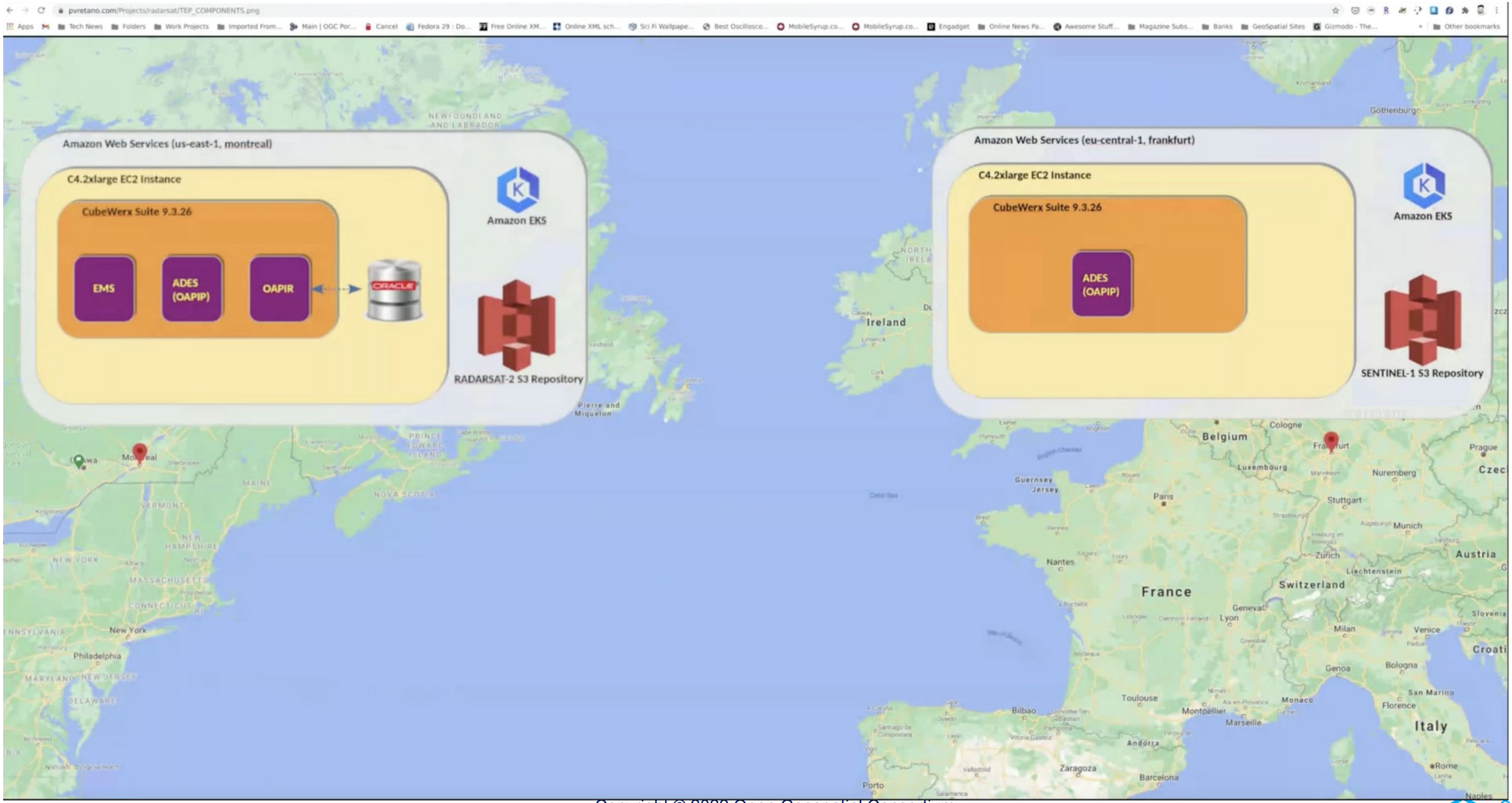

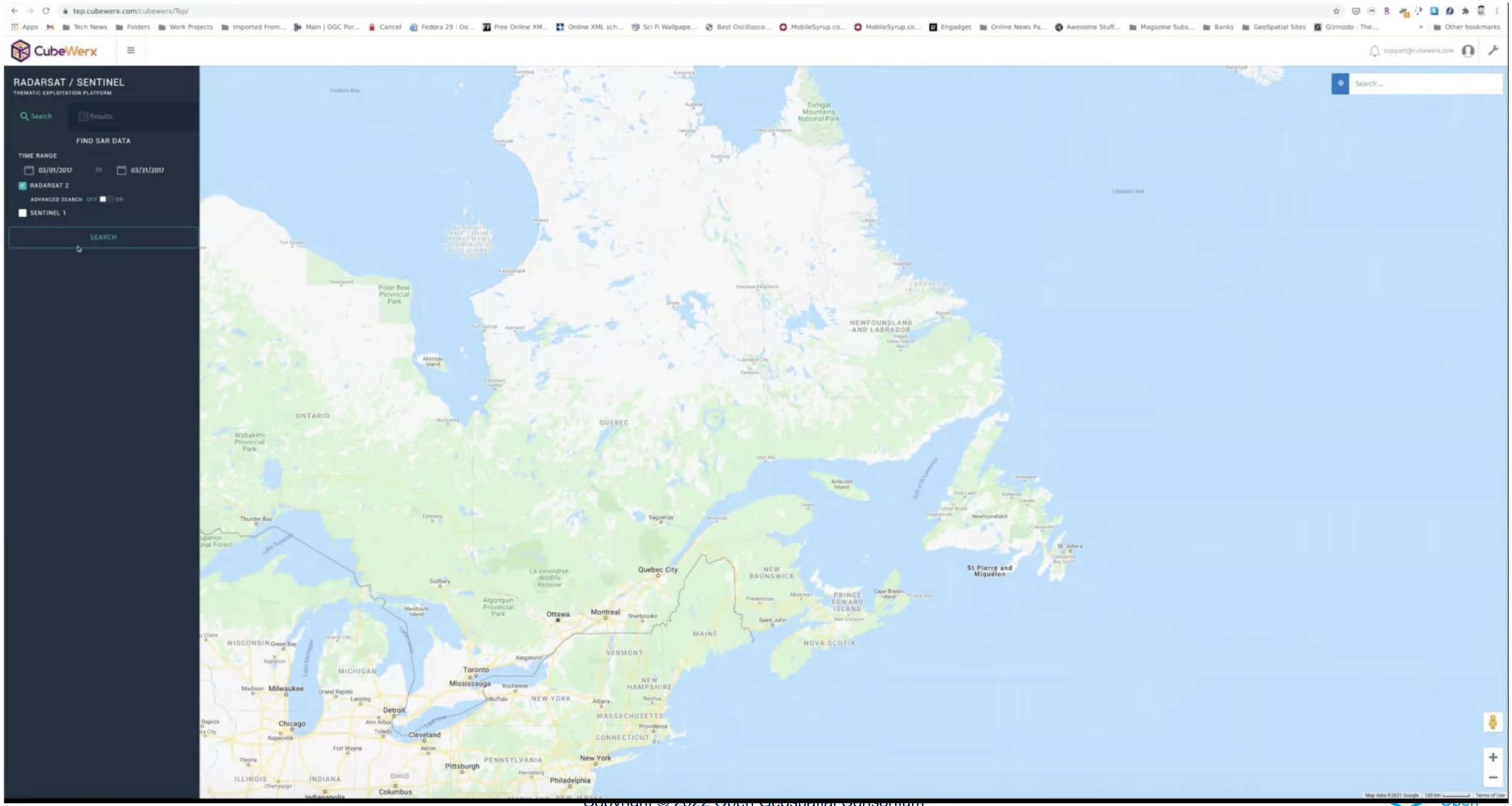

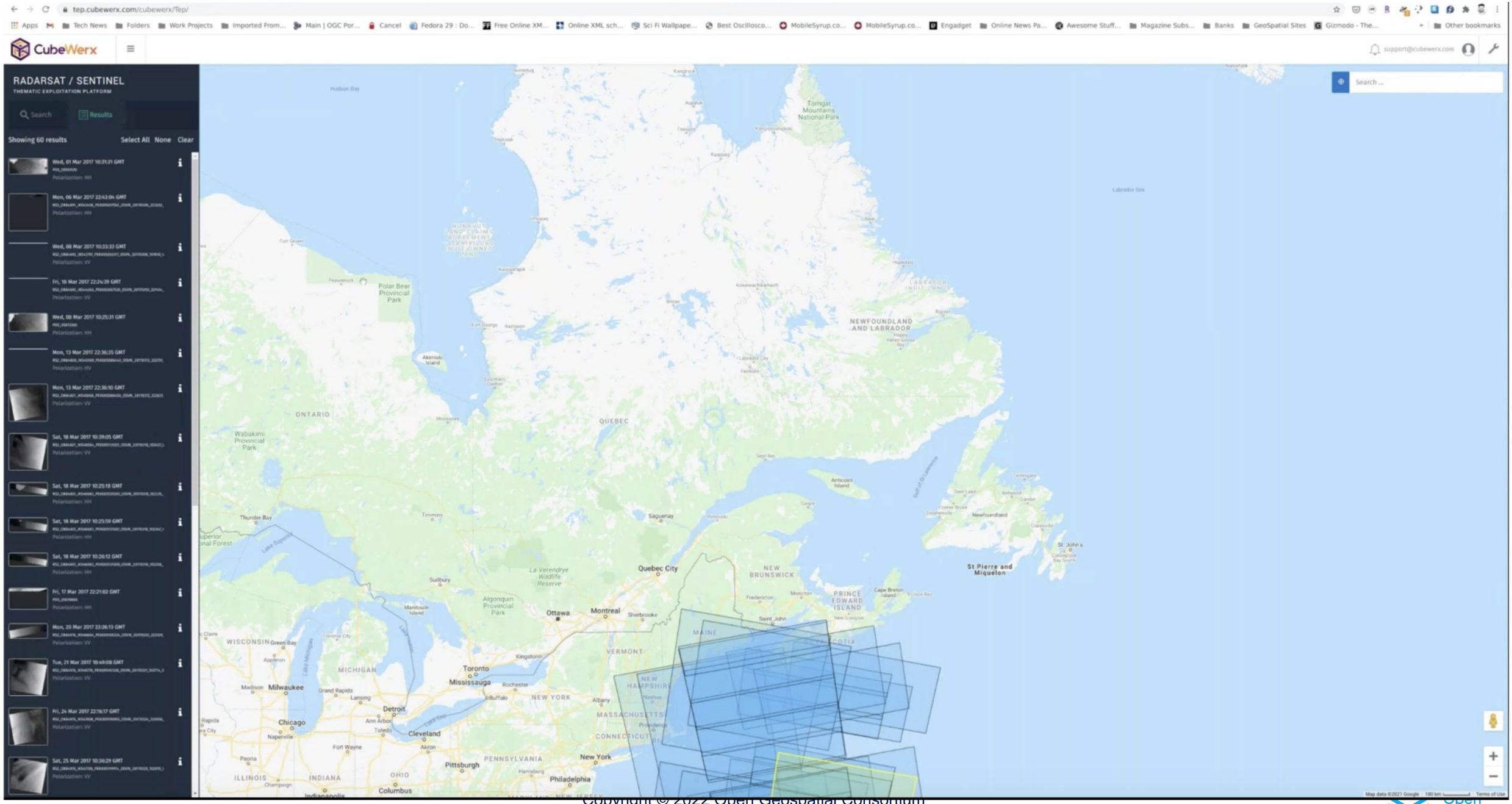

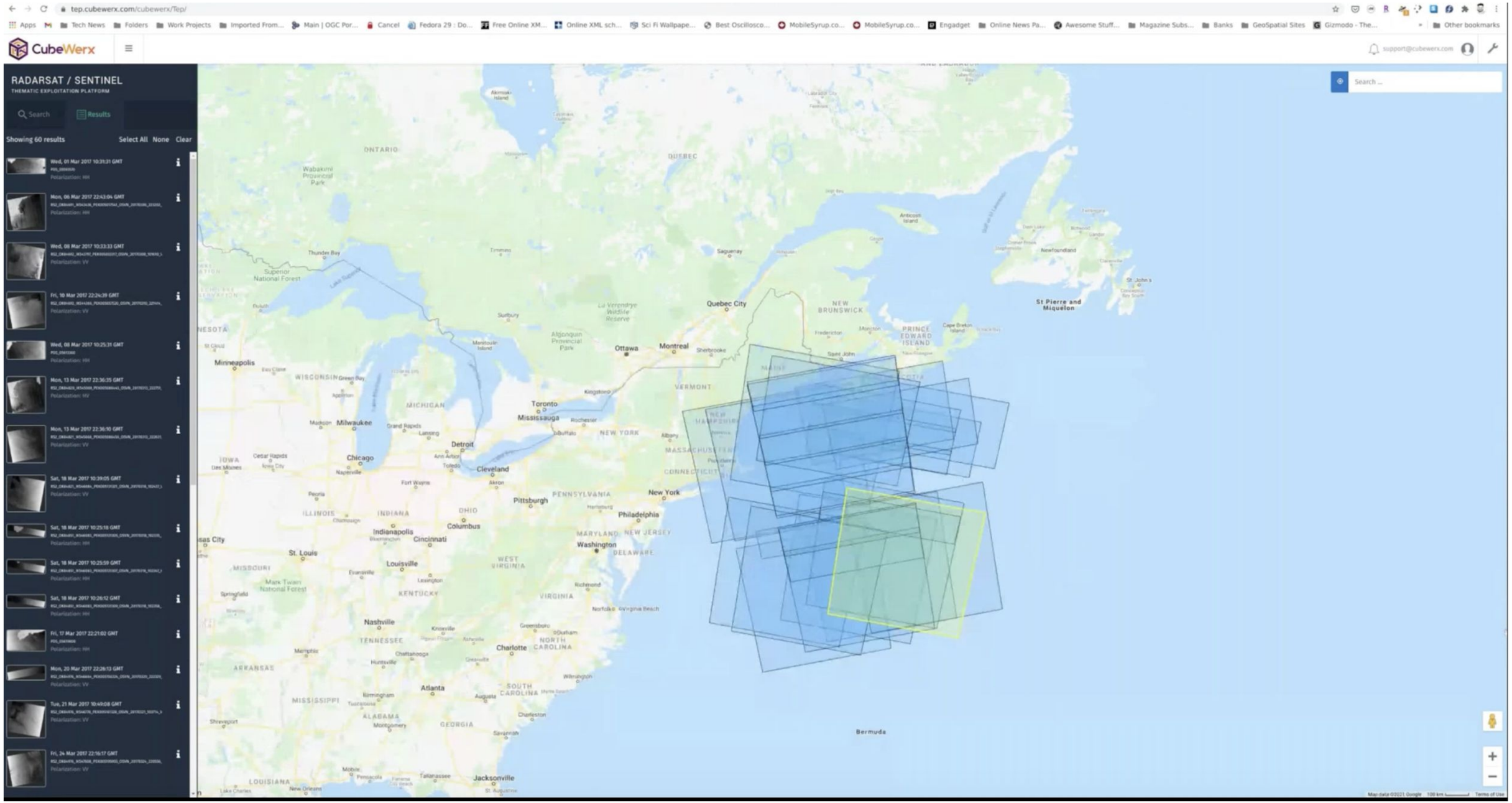

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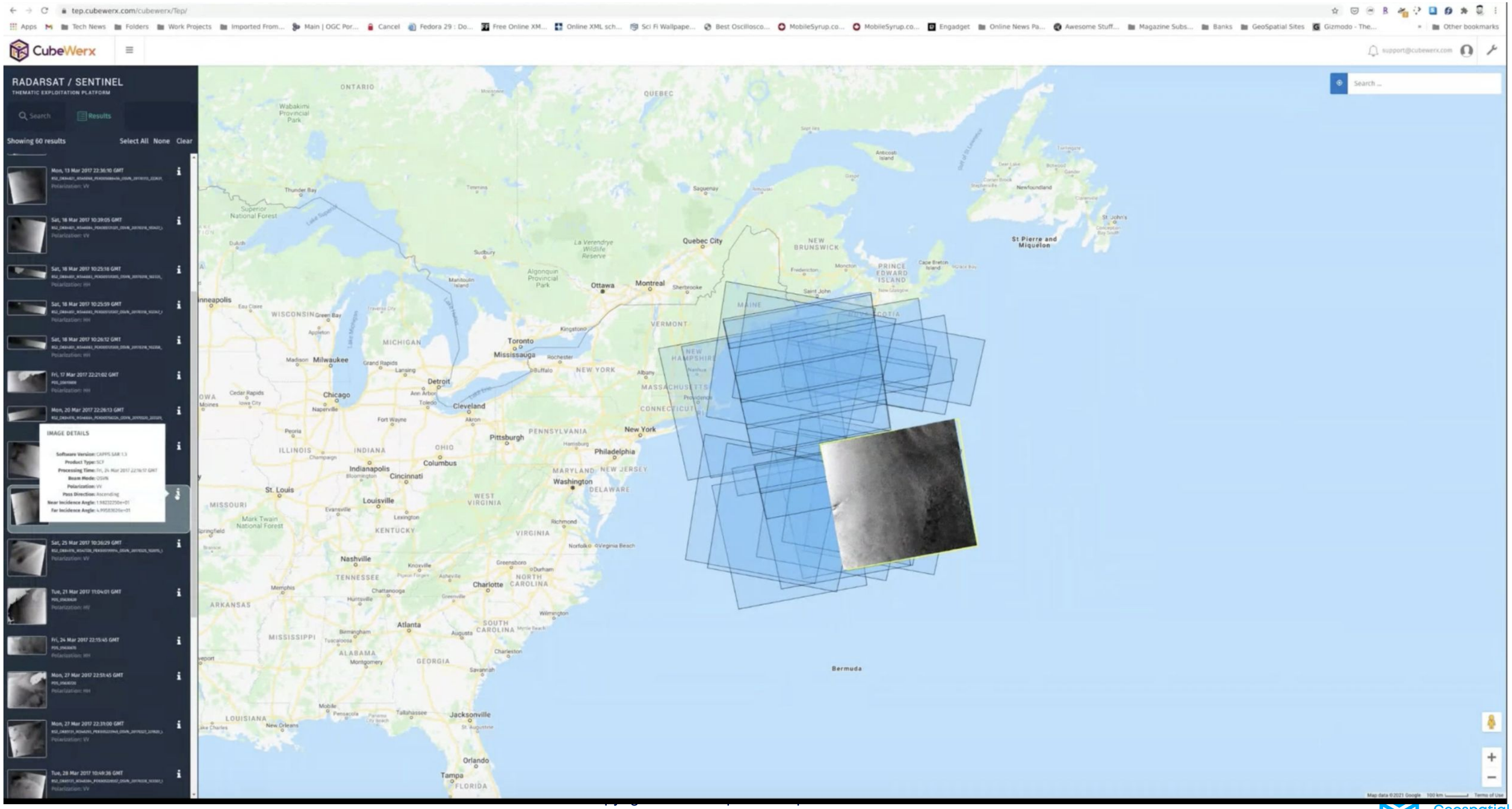
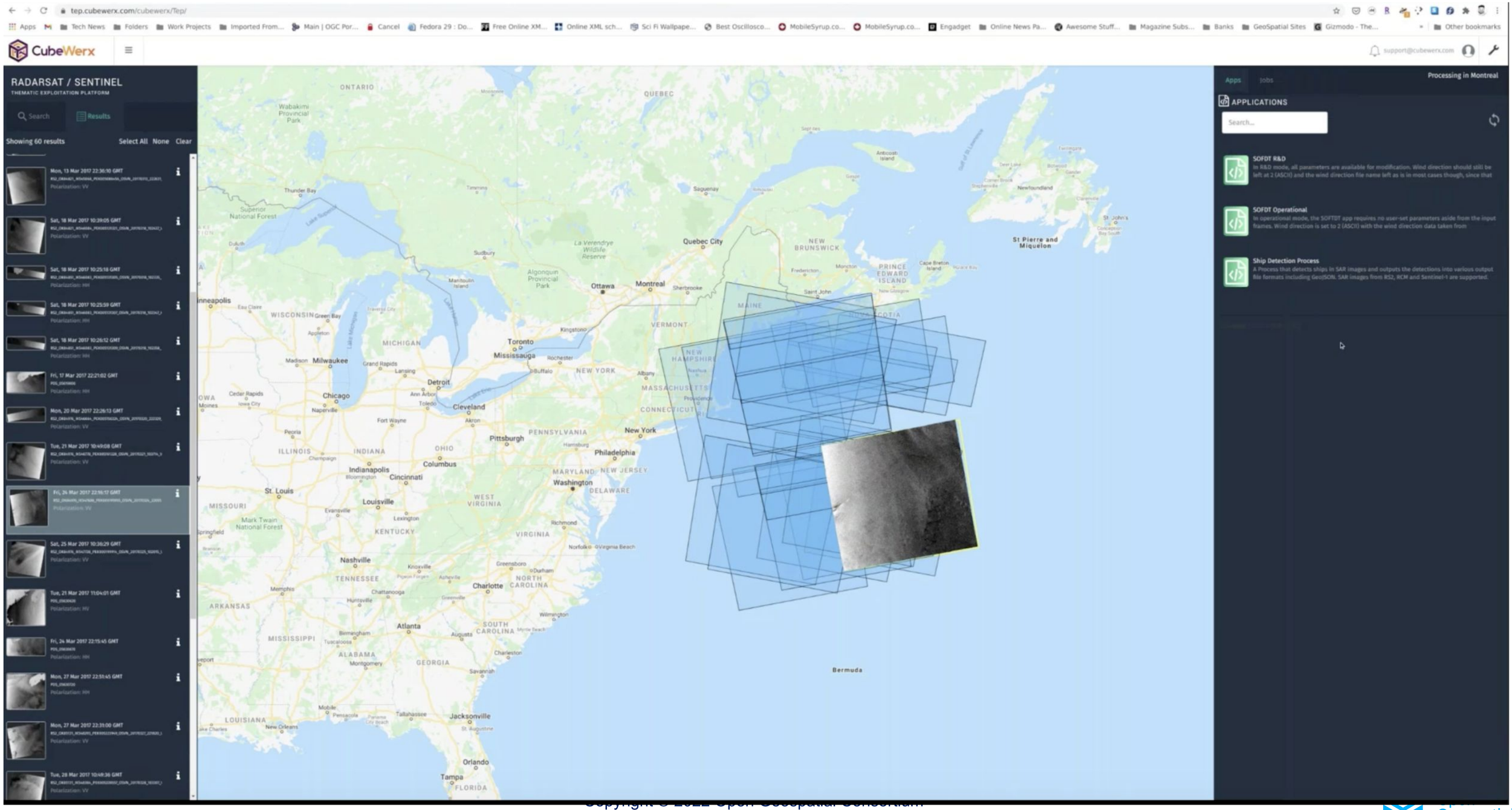
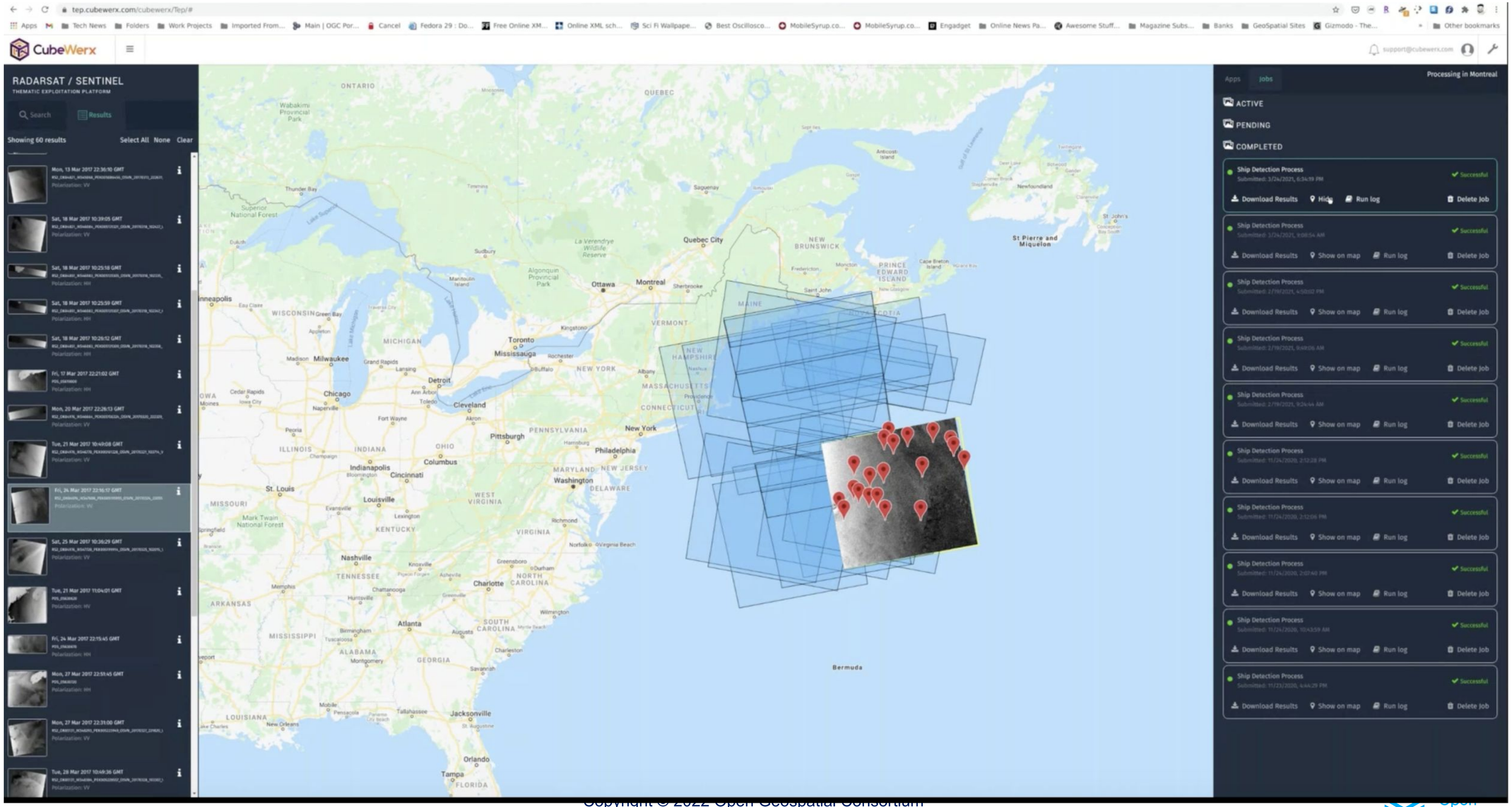


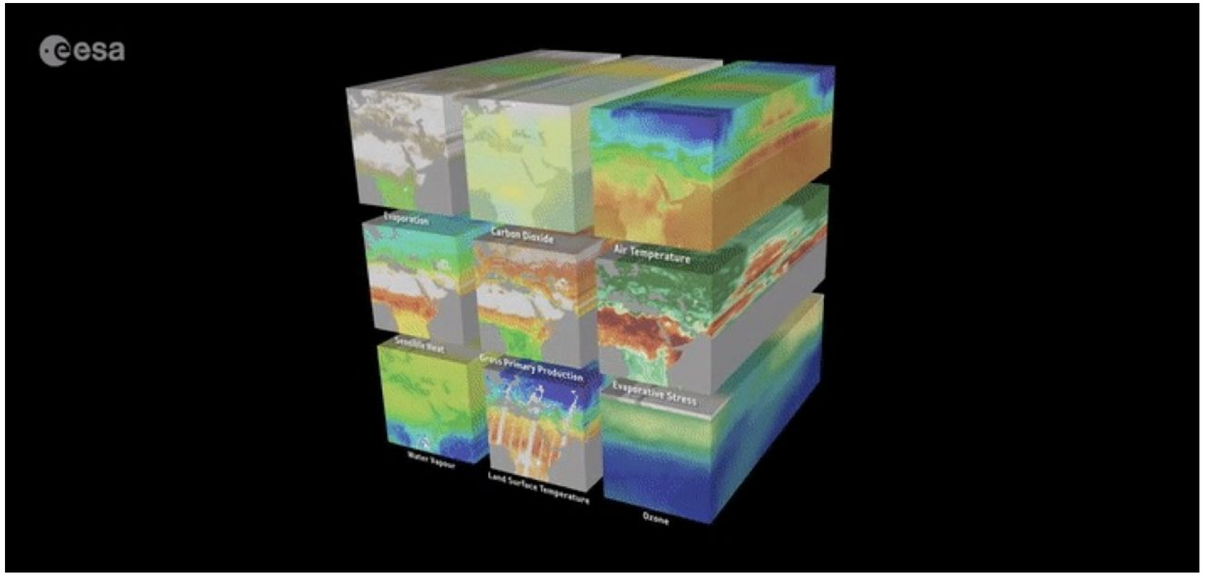




OGC API - Coverages

IN WORK

- Gives access to homogeneous collections of values located in space/time (e.g.: coverages).
- Satellite imagery is typically modeled as a gridded coverage.
- Responses in CoverageJSON, netCDF, GeoTIFF, PNG, HTML and other formats.



Overview of OGC API - Coverages

Resource	Path	HTTP Method	Resource Description	
Landing Page	/	GET	Basic information about this API and the starting point for hypermedia navigation	information about the API
API Definition	/api	GET	An OpenAPI document for this API	
Conformance Classes	/conformance	GET	A list of URLs, one for each implemented Conformance Class	
Collections Metadata	/collections	GET	Information about the collections on this API. Includes partial description of each collection.	named collections
Collection Information	/collections/{coverageid}	GET	The full description of a single collection (coverage).	
Coverage	/collections/{covergaeid}/coverage	GET	The coverage offering (metadata)	the Coverage (CIS)
Coverage Description	/collections/{coverageid}/coverage/description	GET	The Domain Set, Range Type, and Metadata	
Domain Set	/collections/{coverageid}/coverage/domainset	GET	Describes axis and extent.	
Range Type	/collections/{coverageid}/coverage/rangetype	GET	Describes the measures (pixels)	
Range Set	/collections/{coverageid}/coverage/rangeset	GET	The measured values in native format.	
Metadata	/collections/{coverageid}/coverage/metadata	GET	General metadata	
All	/collections/{coverageid}/coverage/all	GET	The Domain Set, Range Type, Range Set, and Metadata	

OGC API - Joins

- Provides an interface to join data from input files either with feature collections that are available on the server or directly with other input files
- Discovery operations, data joining operations and file joining operations

Overview of OGC API - Joins

Resource	Path	HTTP method
Landing page	/	GET
Conformance declaration	/conformance	GET
API definition		GET
Feature collections	/collections	GET
Feature collection	/collections/{collectionId}	GET
Key fields of a specific collection	/collections/{collectionId}/keys	GET
Key values of a specific key field of a specific collection	/collections/{collectionId}/keys/{keyFieldId}	GET
Returns a list of the joins available on the server/ Creates a new join	/joins	GET/ POST
Returns metadata on a specific join/ Deletes a specific join	/joins/{joinId}	GET/DELETE
Joins data between two input files	/filejoin	POST

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OGC API - Records

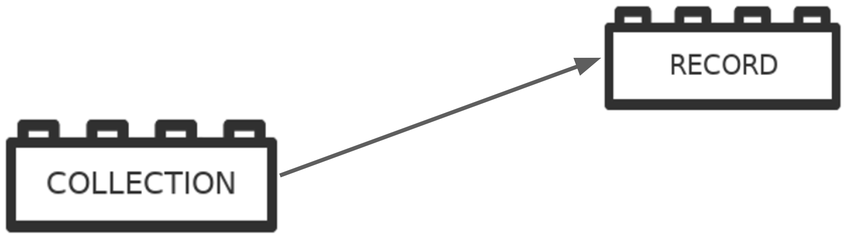
IN WORK

- Provides discovery and access to metadata about geospatial resources.

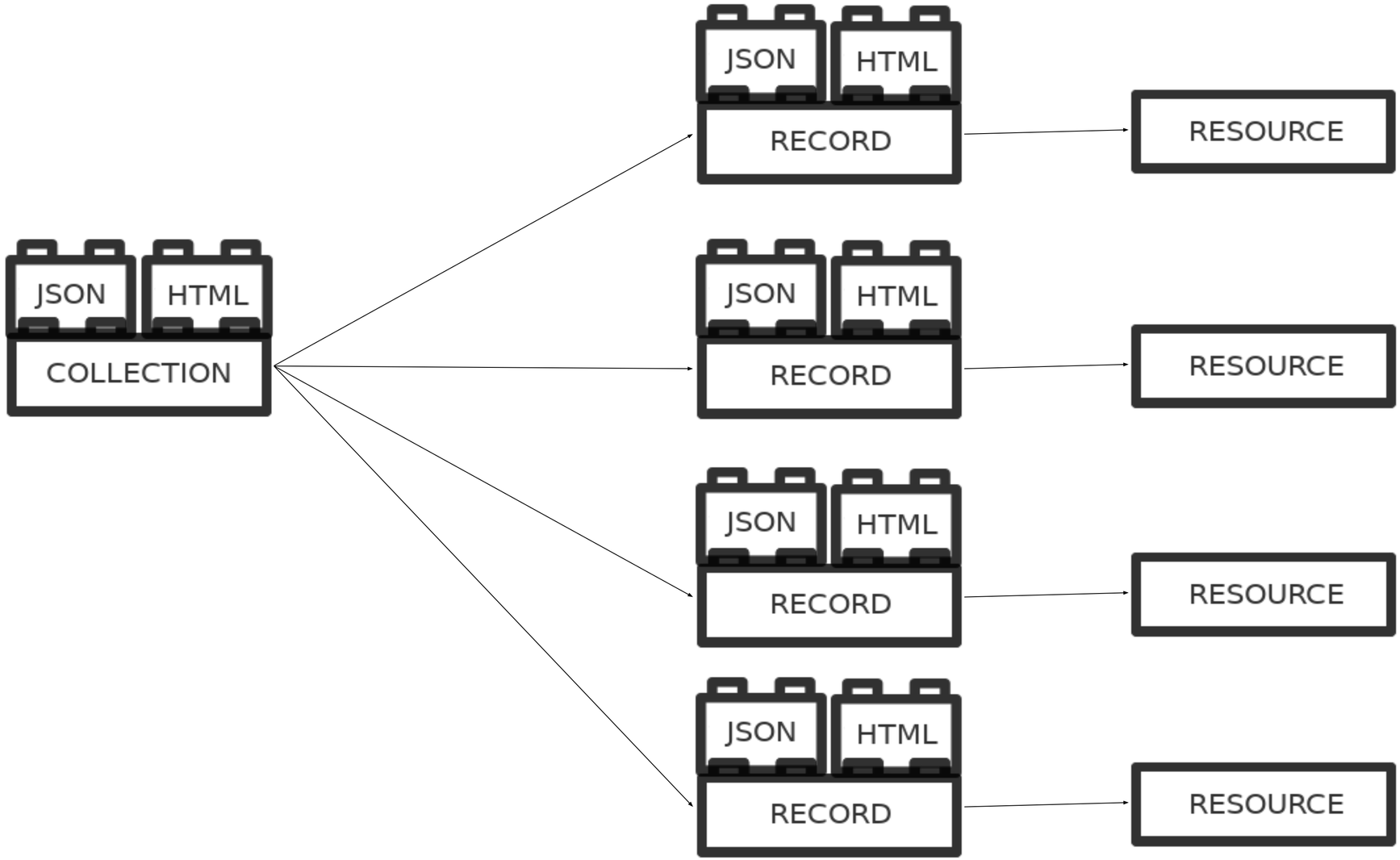
  Provides a series of building blocks.

  The Record is the atomic unit of information in a catalogue.

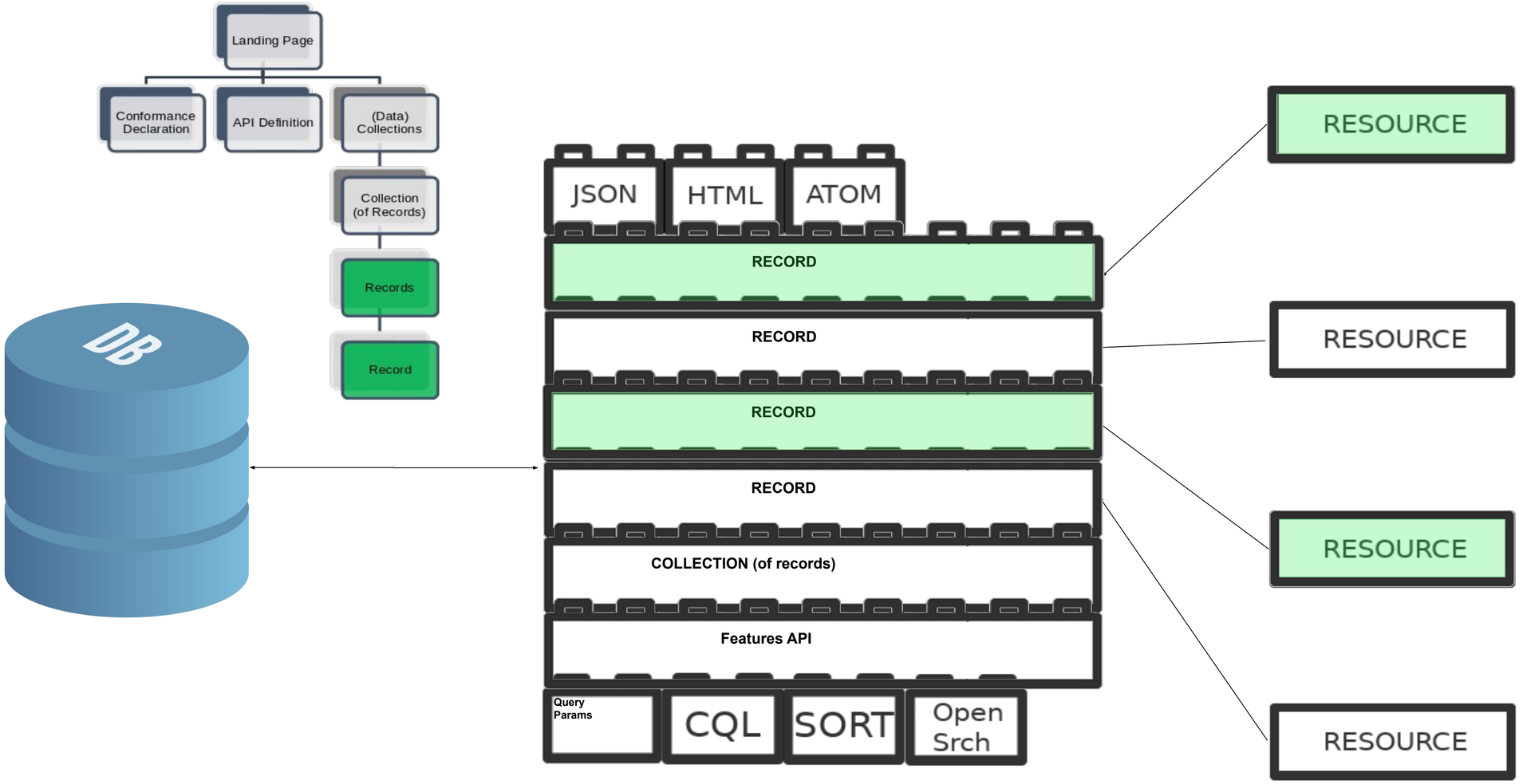
- Deployment patterns based on the building blocks.
- P1 is expected to be aligned with the STAC.



Crawlable Catalogue

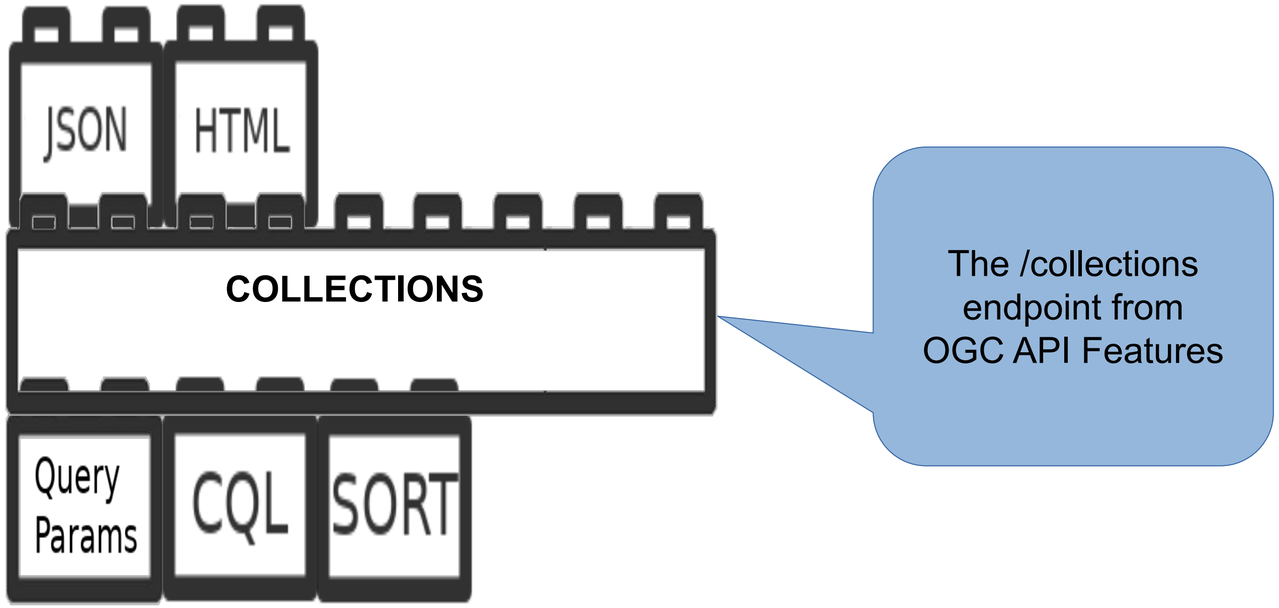


Searchable Catalogue



GET /collections/MyCat/items?bbox=-69.64,37.76,-56.12,46.63&datetime=2020-01-11T00:00:00/2020-01-12T00:00:00

Local Resources Catalogue (/collections example)



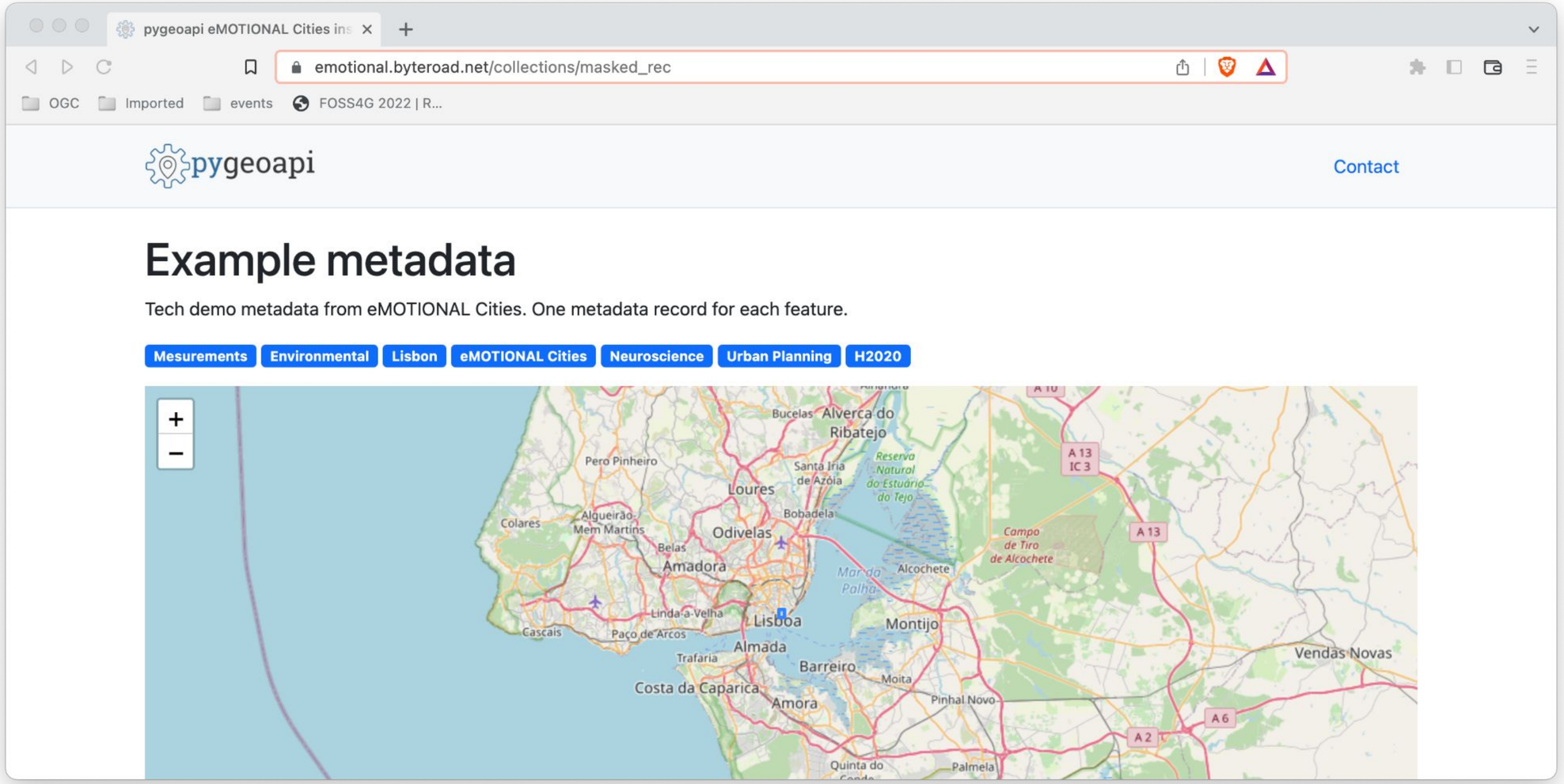
GET /collections?bbox=-69.64,37.76,-56.12,46.63&datetime=2020-01-11T00:00:00/2020-01-12T00:00:00

API endpoints (searchable catalogue)

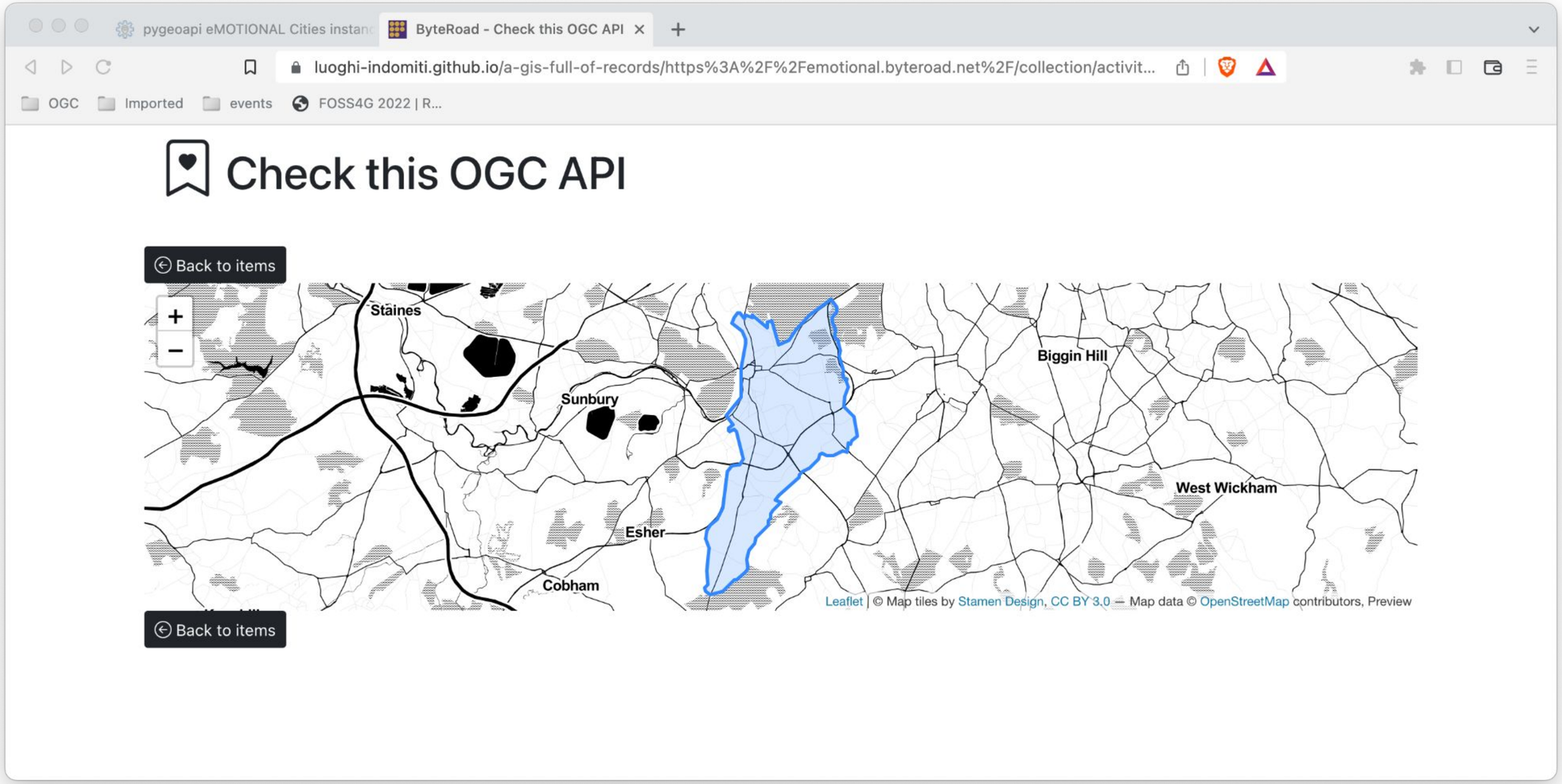
ACCESS PATH	DESCRIPTION
/	GET: Landing page
/api	GET: Service or API description document (OpenAPI)
/conformance	GET: conformance statement
/collections	GET: list of catalogue identifiers with hypermedia controls to each catalogue
/collections/{catalogueId}	GET: Metadata about the specific catalogue including hypermedia controls to other resources POST: create a new catalogue
/collections/{catalogueId}/item	GET: query the catalogue (simple) POST: create a new record
/collections/{catalogueId}/items/{recordId}	GET: get the record PUT: update the record DELETE: remove the record
/collections/{catalogueId}/queryables	GET: list of queryables that can be used in a filter

Example Case Study: OGC API - Records

👉 https://emotional.byteroad.net/



👉 https://luoghi-indomiti.github.io/a-gis-full-of-records/



pygeoapi

CERTIFIED OGC® COMPLIANT

RI ogcapi-features-1 1.0

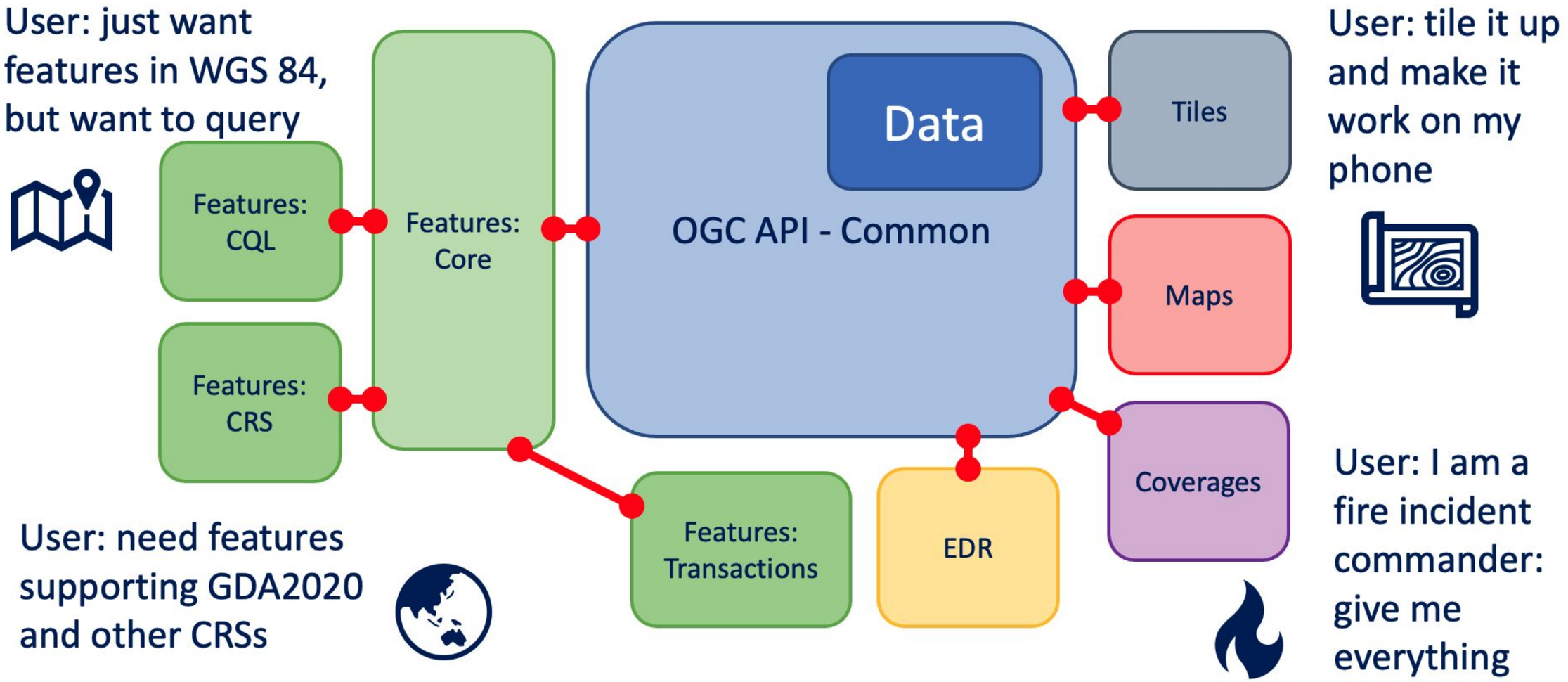
RI ogcapi-edr-1 1.0

Tomorrow, 29/12/22: “API enablement using pygeoapi”

Krishna Lodha

Special guest

Deployment as Building Blocks



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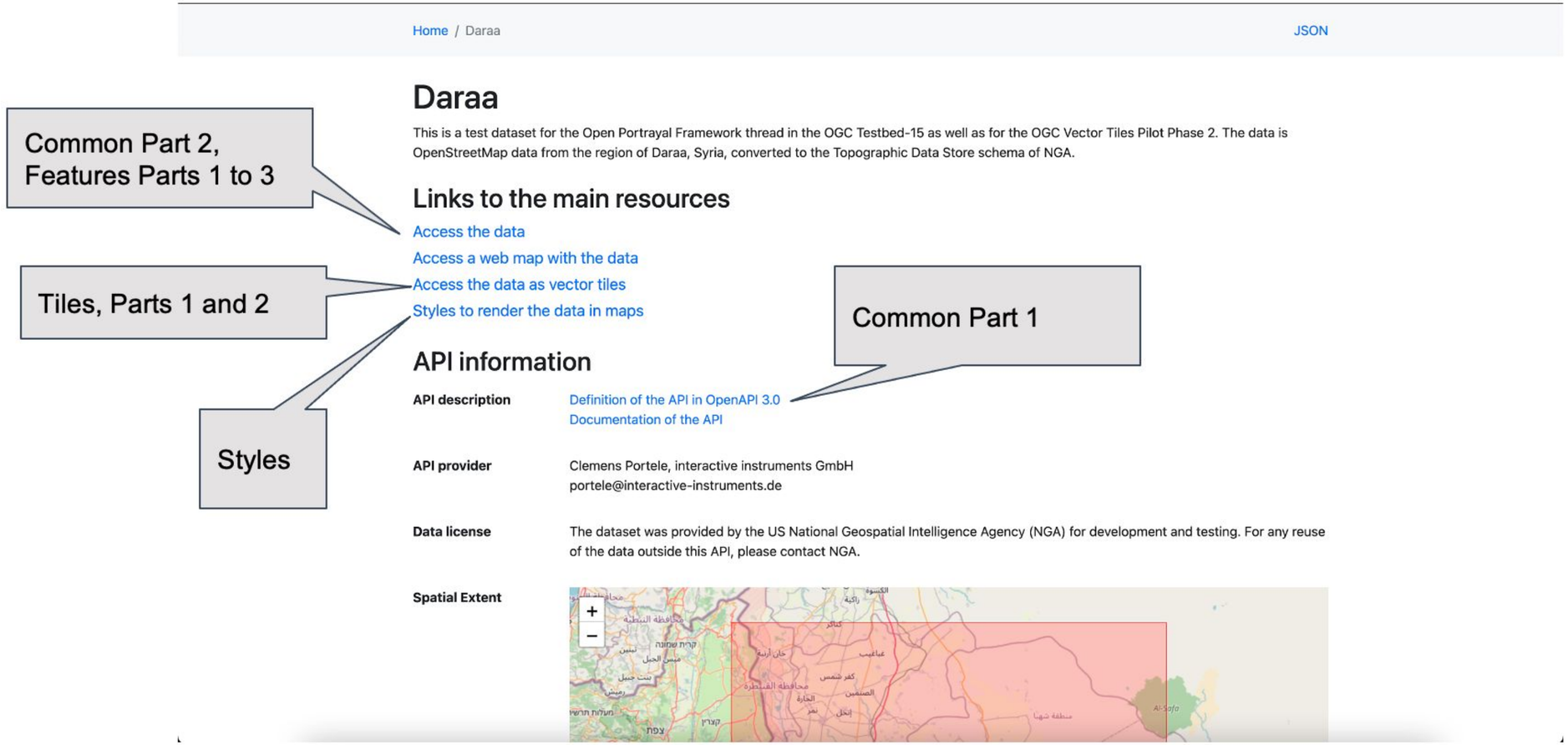
A sample API implementing Common, Features, Tiles, Styles



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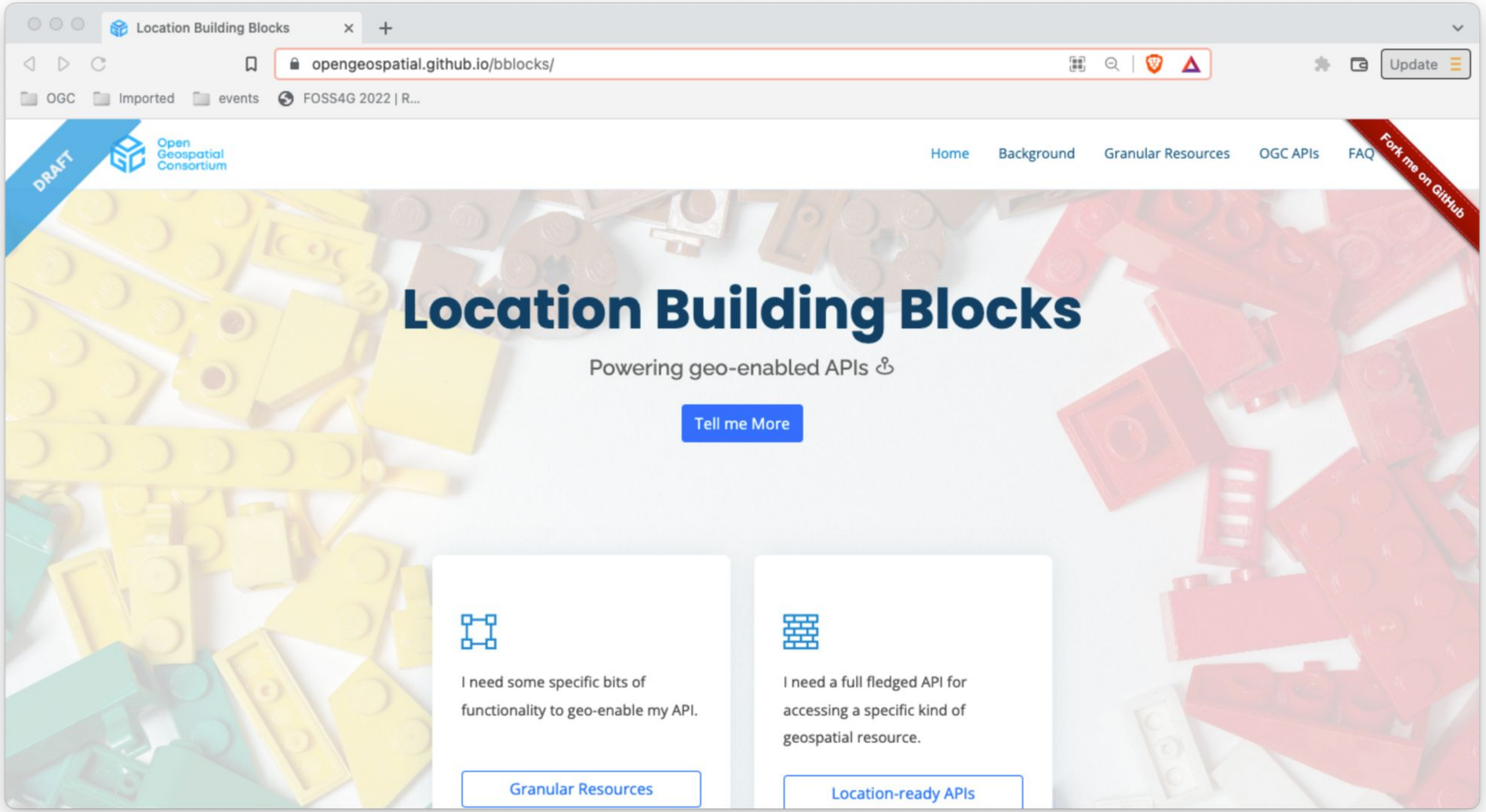
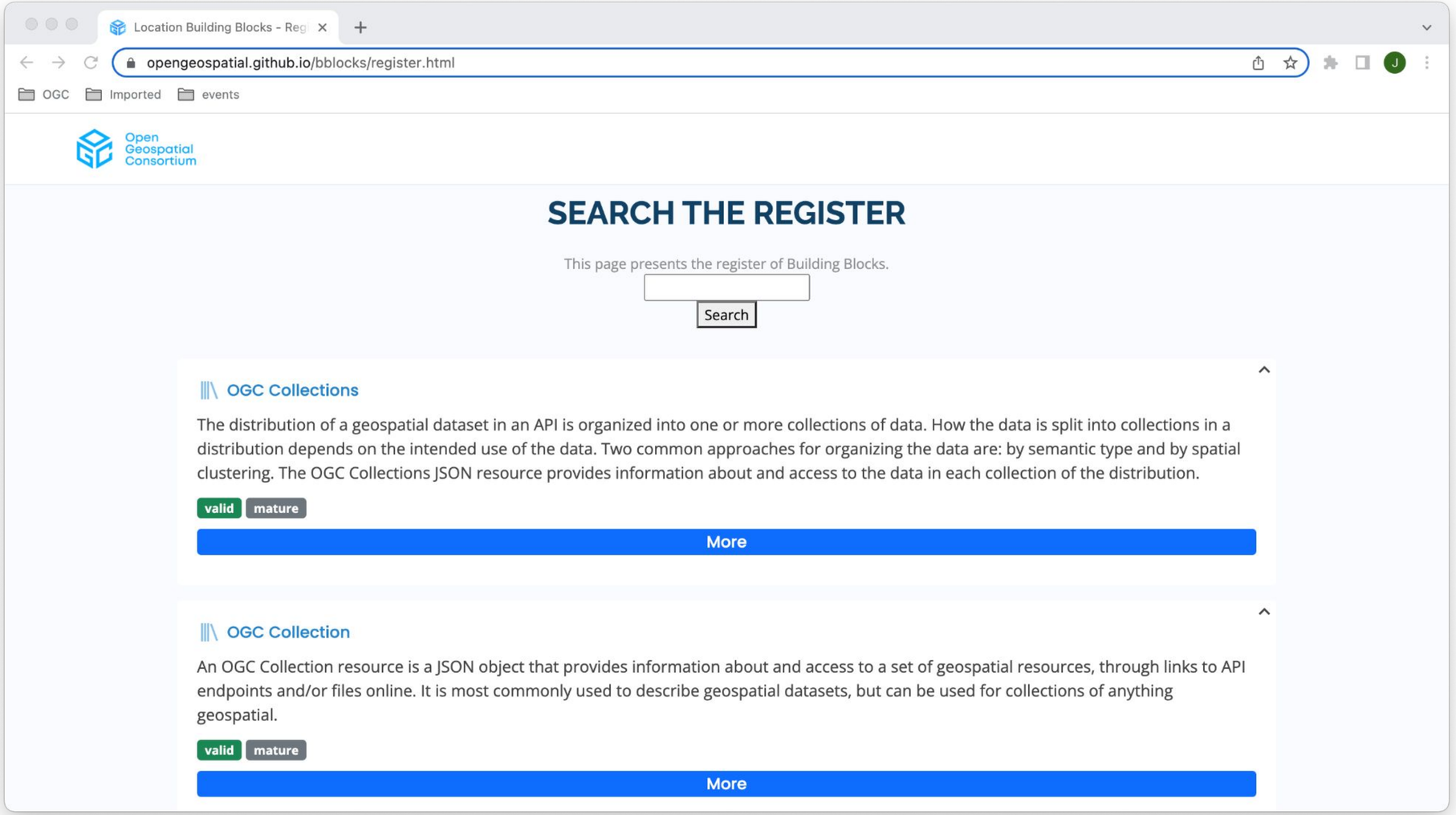
More info: https://blocks.ogc.org/



https://blocks.ogc.org/register.html



Data Encodings

- There are no mandatory encodings.
- API definition/ content negotiation.
- Recommendations: HTML, GeoJSON.

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

Use cases NOT supported in GeoJSON

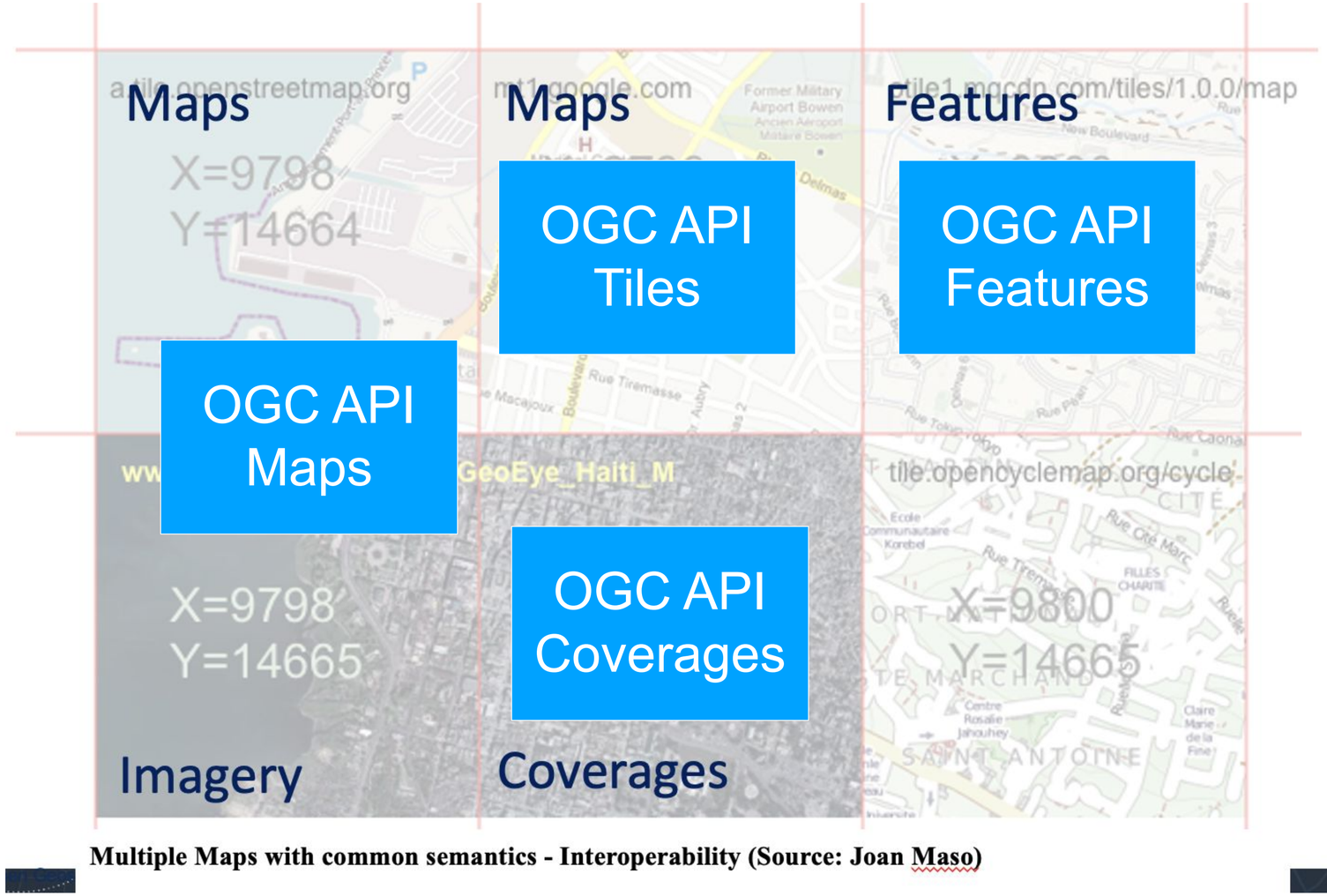
- Geometries in a Coordinate Reference System (e.g.: CRS) other than WGS84.
- Solid geometries.
- Non-Euclidean metrics (e.g.: ellipsoidal metrics).
- Temporal properties.

Features and Geometries JSON (JSON-FG)

- JSON encoding for feature data.
- Superset of GeoJSON, overcoming some of its limitations.
- It is not meant as a translation of GML to JSON.

👉 https://github.com/opengeospatial/ogc-feat-geo-json

Migration OWS -> OGC APIs



Multiple Maps with common semantics - Interoperability (Source: Joan Maso)

Discover via

OGC API Records

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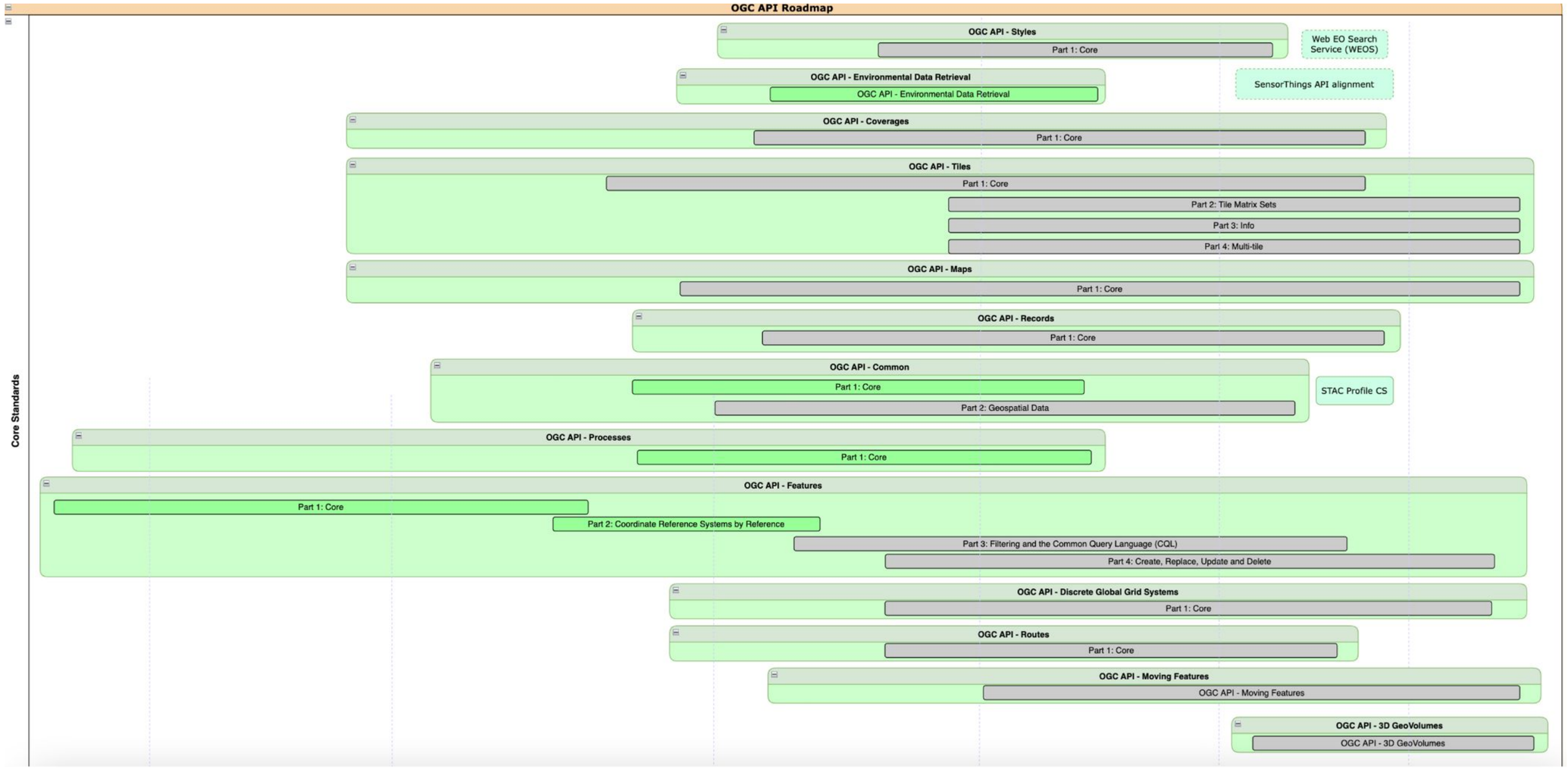
Deprecation of OWS

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

OGC API Roadmap

https://ogcapi.ogc.org/apiroadmap.html



2017 2018 2019 2022 2023

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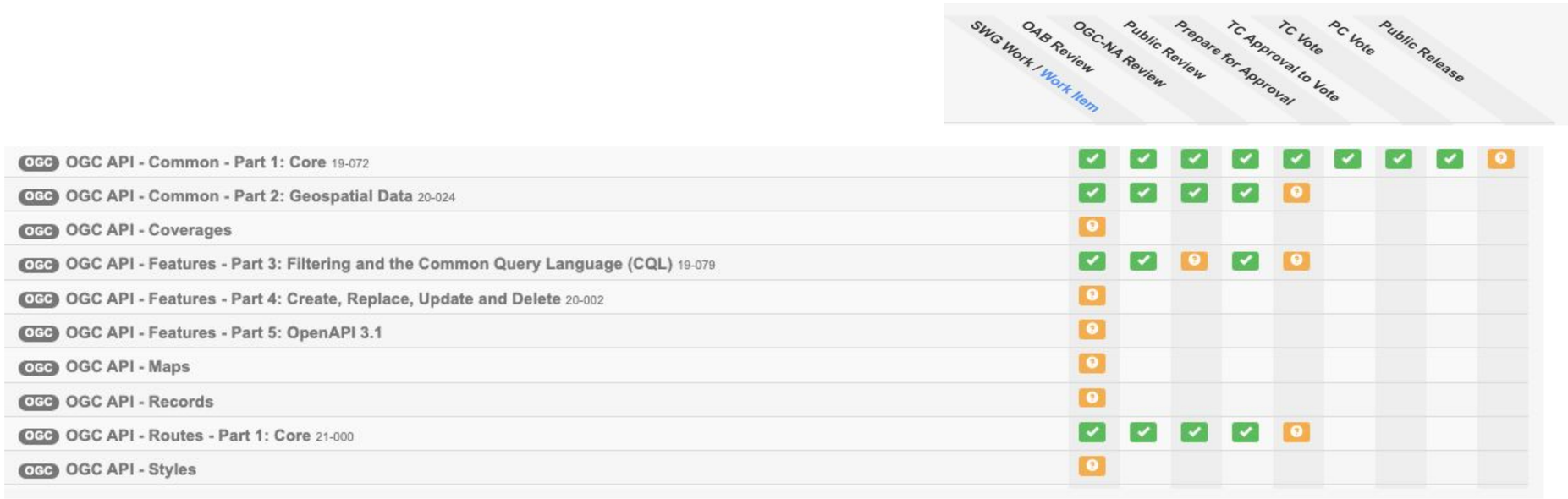
Work in Progress

https://www.ogc.org/roadmap



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How to get Involved with the OGC APIs?

Participate as a member ✓

- Join and participate in the relevant Domain & Standard Working Groups.

Follow the GitHub repos ✓

- Create issues.
- Contribute with PRs.

Join the code sprints ✓

- Build/ update implementations.
- Provide feedback.
- Sponsoring.

Test/certify Implementations ✓

- Increase interoperability.
- Engage with the compliance program.

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OGC Working Groups

- **Standard Working Groups (SWGs):** groups that work in new standards or standards revisions, through the OGC RFC process. Examples:
  - Features API SWG, OGC API - Tiles SWG, Coverages SWG, Routing SWG, Geocoding API SWG, Features and Geometries JSON SWG, OGC Geopackage SWG.

- **Domain Working Groups (DWGs):** groups that address interoperability requirements and issues of specific domains.

3DIM DWG ✓

- Interface and encoding standards for 3-dimensional content

Data Quality DWG ✓

- Interoperable framework or model for OGC quality measures and services

Smart Cities DWG ✓

- Mobile and static networks to support the data, application and monitoring requirements of the Smart Cities

Metaverse DWG ✓

- Will work on pieces of the Metaverse that pertain to geospatial applications and Standards

Starting

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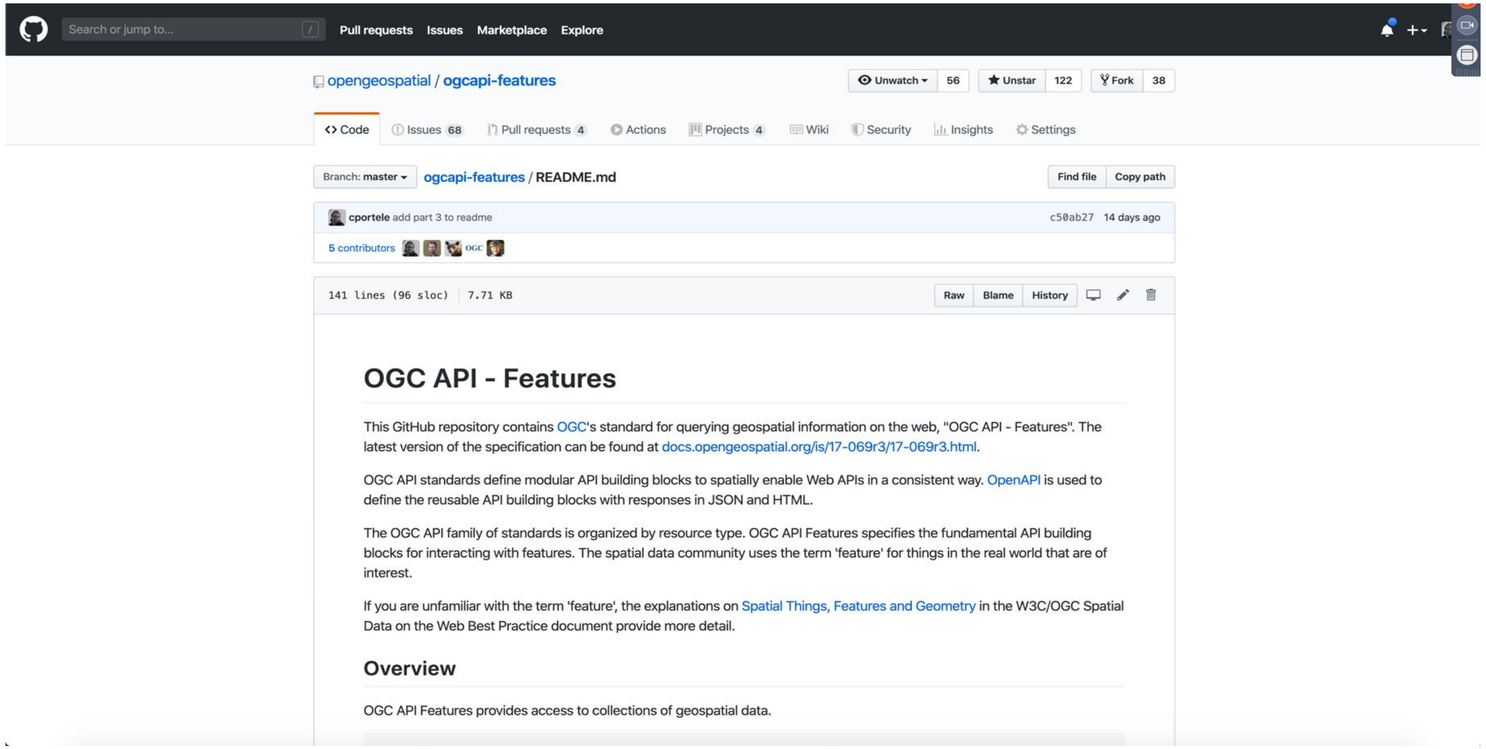
OGC API GitHub Repos

- Join the discussions.
- File issues.
- Submit PR.

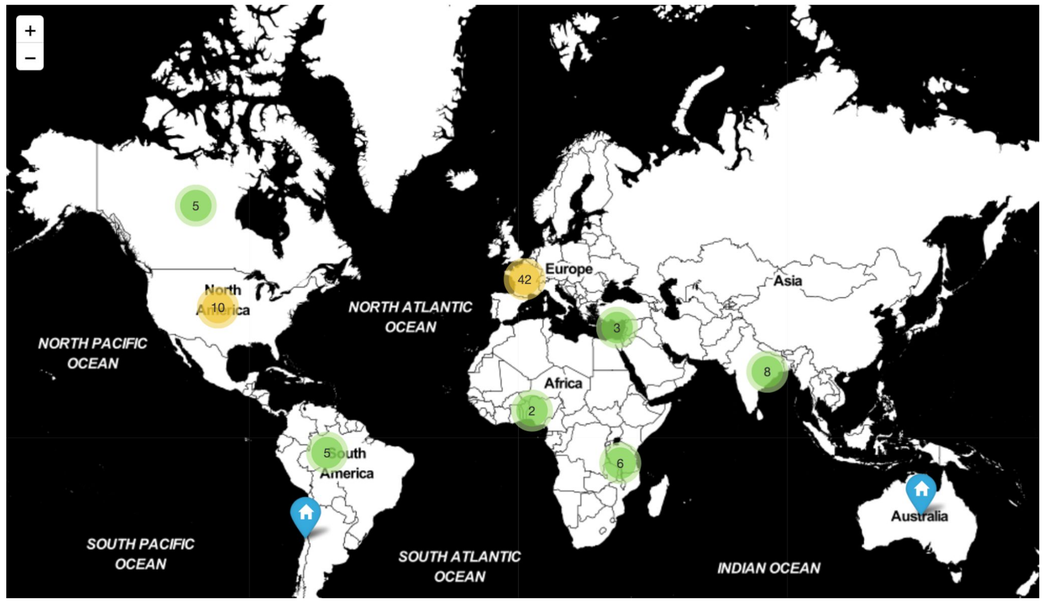
👉 **https://github.com/opengeospatial/**



OGC Code Sprints

Join the OGC Events Discord Channel

- Three-day collaborative, hybrid, events
- Held regularly
- Open to all OGC API standards
- Feature a mentor stream, to onboard newcomers
- Feature developers from across the globe



Source: Web Mapping Code Sprint - November 2022

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Code Sprints in 2023

Upcoming Events

- Q1 - March/April - Europe (Switzerland)
- Q2 - June - NA (US)
- Q3 - September - Europe

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

👉 https://github.com/opengeospatial/developer-events/wiki

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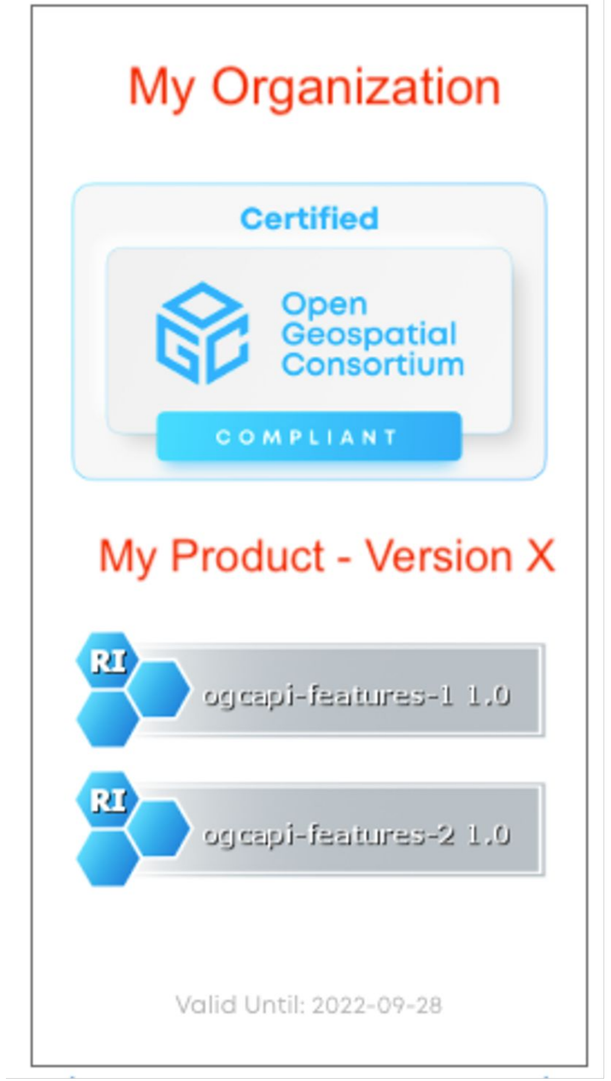
Test/certify Implementations

- The OGC Compliance Program provides the resources, procedures, and policies to certify products for compliance with one or more OGC standards.
- The primary purpose of the program is to increase systems interoperability while reducing technology risks by providing a process whereby compliance with OGC standards can be tested.



OGC Compliance Badge

👉 **https://www.ogc.org/compliance**

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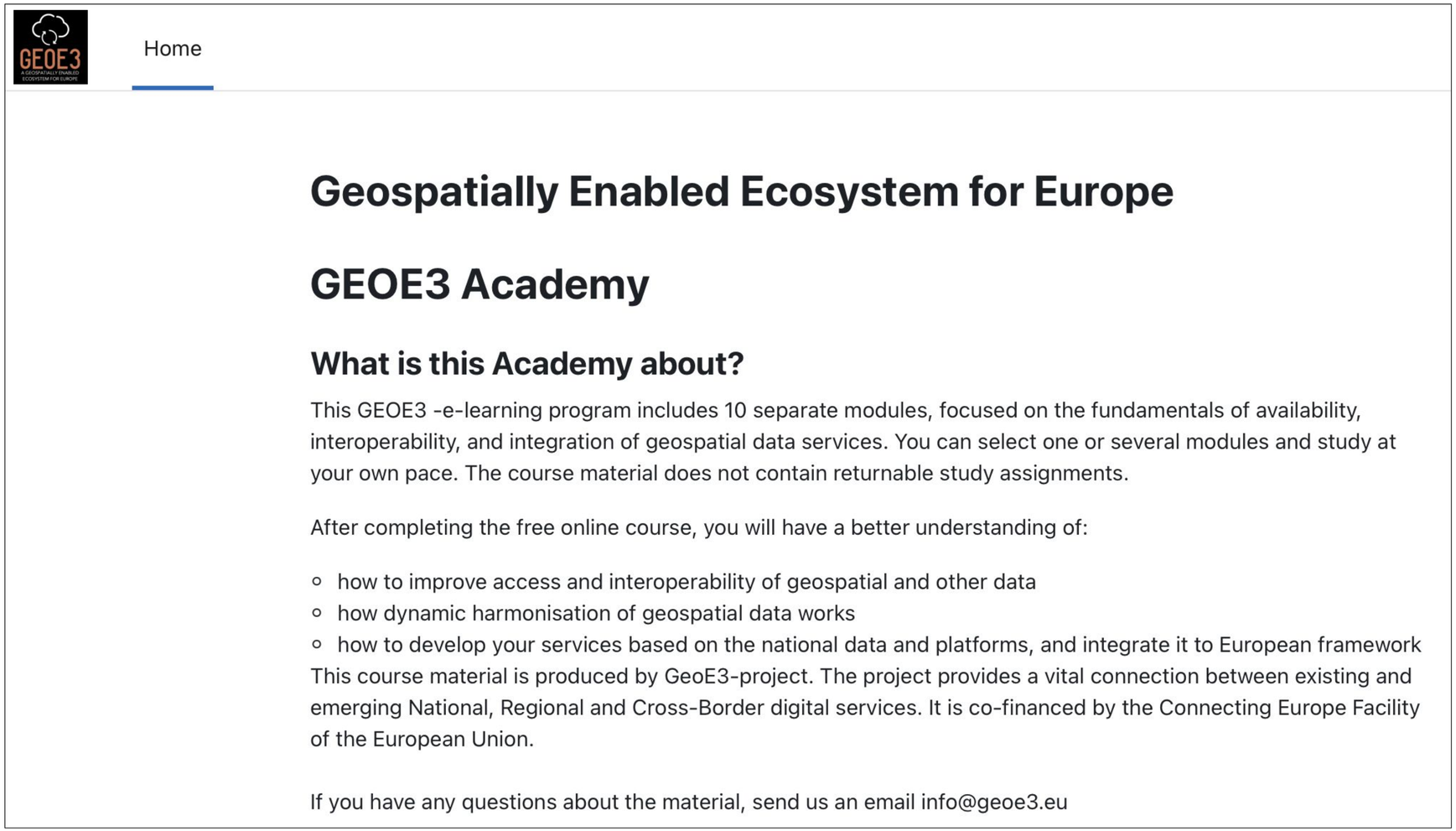
GEOE3 Academy

https://geoe3.ogc.org



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Summary

- OGC API Standards are becoming a key requirement for Web APIs offering location-referenced information
- Early impact has already been seen across government, private and academic sectors
- Organizations should spatially enable their Web APIs through OGC API Standards to ensure their data is Findable, Accessible, Interoperable, and Reusable (FAIR)

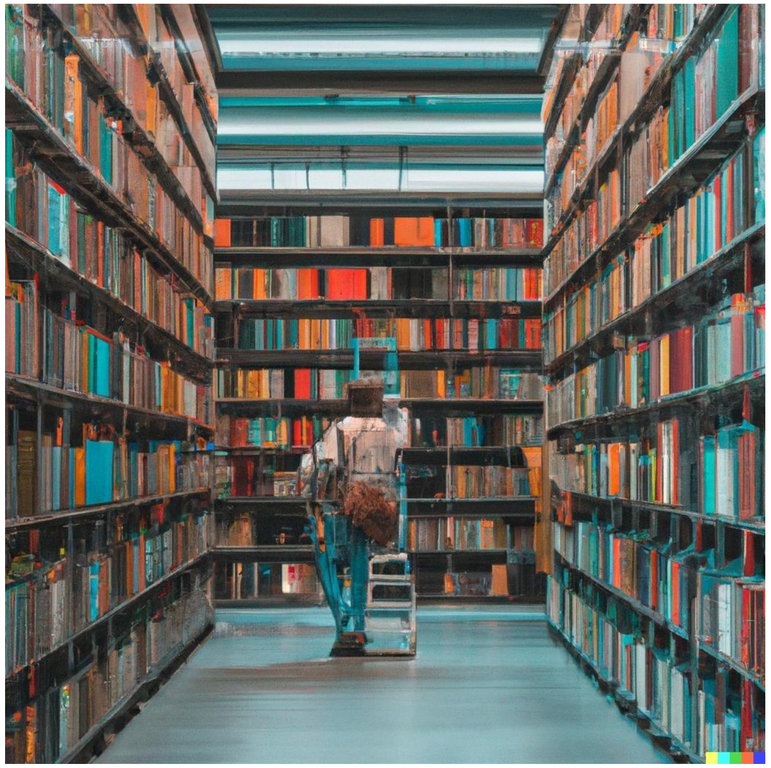

Image generated with DALL.E 2 :https://openai.com/dall-e-2/

#OGCAPI

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Thank You

Community

500+ International Members
110+ Member Meetings
60+ Alliance and Liaison partners
50+ Standards Working Groups
45+ Domain Working Groups
25+ Years of Not for Profit Work
10+ Regional and Country Forums

Innovation

120+ Innovation Initiatives
380+ Technical reports
Quarterly Tech Trends monitoring

Standards

65+ Adopted Standards
300+ products with 1000+ certified implementations
1,700,000+ Operational Data Sets
Using OGC Standards

devrel@ogc.org
joanasimoes
@doublebyte@noc.social
@doublebyte1

Questions?