

July 2021 OGC API Code Sprint Summary Engineering Report

Publication Date: YYYY-MM-DD

Approval Date: YYYY-MM-DD

Submission Date: YYYY-MM-DD

Reference number of this document: OGC 21-055

Reference URL for this document: <http://www.opengis.net/doc/PER/202107APISprintER-ID>

Category: OGC Public Engineering Report

Editor: Gobe Hobona, Joana Simoes

Title: July 2021 OGC API Code Sprint Summary Engineering Report

OGC Public Engineering Report

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Chapter 1. Subject

The subject of this Engineering Report (ER) is a virtual code sprint that was held from July 21st to July 23rd, 2021 to advance the development of the OGC API - Processes draft standard, OGC API - Records draft standard, and the OGC API - Coverages draft standard. An Application Programming Interface (API) is a standard set of documented and supported functions and procedures that expose the capabilities or data of an operating system, application or service to other applications (adapted from ISO/IEC TR 13066-2:2016).

Chapter 2. Executive Summary

This Engineering Report (ER) summarizes the main achievements of the July 2021 OGC API Virtual Code Sprint, conducted from July 21st to July 23rd. The goal of the code sprint was to progress the development of the draft OGC API standards for Records, Coverages and Processes. The sprint served to accelerate development of candidate standards of the OGC APIs.

Specifically, the objectives of the code sprint were to:

- Develop prototype implementations of OGC API – Processes
- Develop prototype implementations of OGC API – Records
- Develop prototype implementations of OGC API – Coverages
- Test the prototype implementations
- Provide feedback to the Editor about what worked and what did not work
- Provide feedback about the specification document, especially what is missing from the document

Part of the motivation for holding the sprint was:

- APIs are a popular, effective method for rapid software development
- There is an increasing need for interoperability between Web APIs
- The growing uptake of location within and outside of geospatial developer communities

The draft OGC API - Processes specification defines an interface that enables the execution of geospatial computing processes and the retrieval of metadata describing their purpose and functionality. Typically, these processes execute well-defined algorithms that ingest vector and/or coverage data to produce new datasets.

The draft OGC API - Records specification defines an interface that enables discovery and access to metadata records about resources such as features, coverages, tiles / maps, models, assets, services or widgets. The draft specification enables the discovery of geospatial resources by standardizing the way collections of descriptive information about the resources (metadata) are exposed and accessed.

The draft OGC API - Coverages specification defines an interface that enables access to coverages that are modeled according to the Coverage Implementation Schema (CIS) 1.1. Coverages are represented by some binary or ASCII serialization, specified by some data (encoding) format. Arguably the most popular type of coverage is that of a gridded coverage. Gridded coverages have a grid as their domain set describing the direct positions in multi-dimensional coordinate space, depending on the type of grid. Satellite imagery is typically modeled as a gridded coverage, for example.

The code sprint successfully met all of its objectives and achieved its goal of progressing the development of the OGC API - Processes draft standard, OGC API - Records draft standard, and the OGC API – Coverages draft standard. There were no issues found on the Processes API, which helped to validate the maturity and stability of the API. Discussion about the Records API helped to improve understanding of the potential relationship to other related specifications (e.g. STAC and ISO 19115). Issues raised relating to the Coverages API were focused around clarification, thereby identifying areas where the documentation could be improved. The sprint participants demonstrated that the OGC API pattern can effectively address the needs of communities that use, process and analyze geospatial data.

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All questions regarding this document should be directed to the editor or the contributors:

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Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Chapter 3. References

The following normative documents are referenced in this document.

- OGC: OGC 18-062, OGC API - Processes - Part 1: Core candidate standard [<http://docs.ogc.org/DRAFTS/18-062.html>]
- OGC: OGC 20-004, OGC API - Records - Part 1: Core candidate standard [<http://docs.ogc.org/DRAFTS/20-004.html>]
- OGC: OGC 19-087, OGC API - Coverages - Part 1: Core candidate standard [<http://docs.ogc.org/DRAFTS/19-087.html>]
- ISO 19115-1:2014, Geographic information — Metadata — Part 1: Fundamentals [<https://www.iso.org/standard/53798.html>]
- ISO 19115-2:2019, Geographic information — Metadata — Part 2: Extensions for acquisition and processing [<https://www.iso.org/standard/67039.html>]
- ISO/TS 19115-3:2016, Geographic information - Metadata - Part 3: XML schema implementation for fundamental concepts (2016) [<https://www.iso.org/standard/32579.html>]
- IETF: RFC-7946 The GeoJSON Format (2016)

Chapter 4. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard **OGC 06-121r9** [https://portal.opengeospatial.org/files/?artifact_id=38867&version=2] shall apply. In addition, the following terms and definitions apply.

- *coordinate reference system*

coordinate system that is related to the real world by a datum term name (source: ISO 19111)

- *coverage*

feature that acts as a function to return values from its range for any direct position within its spatiotemporal domain, as defined in OGC Abstract Topic 6

- *record*

atomic unit of information of a catalogue that is used to provide information about a particular resource

- *OpenAPI Document*

A document (or set of documents) that defines or describes an API. An OpenAPI definition uses and conforms to the OpenAPI Specification (<https://www.openapis.org>)

- *Web API*

API using an architectural style that is founded on the technologies of the Web [source: OGC API - Features - Part 1: Core]

NOTE

See Best Practice 24: Use Web Standards as the foundation of APIs (W3C Data on the Web Best Practices) for more detail.

4.1. Abbreviated terms

- **API** Application Programming Interface
- **CORS** Cross-Origin Resource Sharing
- **OGC** Open Geospatial Consortium

Chapter 5. Introduction

This Engineering Report (ER) summarizes the main achievements of the July 2021 OGC API Virtual Code Sprint, conducted from July 21st to July 23rd. The sprint had been organized to advance the development of draft standards of OGC APIs for Records, Coverages and Processes. Sprint participants prototyped implementations of the draft standards, validating the requirements and providing feedback so that the draft standards could be improved.

An OGC Code Sprint is a collaborative and inclusive event driven by innovative and rapid programming with minimal process and organization constraints to support the development of new applications and open standards. OGC Code Sprints experiment with emerging ideas in the context of geospatial standards, help improve interoperability of existing standards by experimenting with new extensions or profiles, and are used for building proofs of concept for other OGC Innovation Program initiatives, or to support OGC Standards Program activities.

Chapter 6. High-Level Architecture

6.1. High Level Overview

The code sprint was executed in support of the development of the draft [OGC API - Records](https://ogcapi.ogc.org/records) [<https://ogcapi.ogc.org/records>], [OGC API - Processes](https://ogcapi.ogc.org/processes) [<https://ogcapi.ogc.org/processes>] and [OGC API - Coverages](https://ogcapi.ogc.org/coverages) [<https://ogcapi.ogc.org/coverages>] standards. Implementations of these draft standards were deployed in participants' own infrastructure in order to build a solution with the architecture shown below in [Figure 1](#).

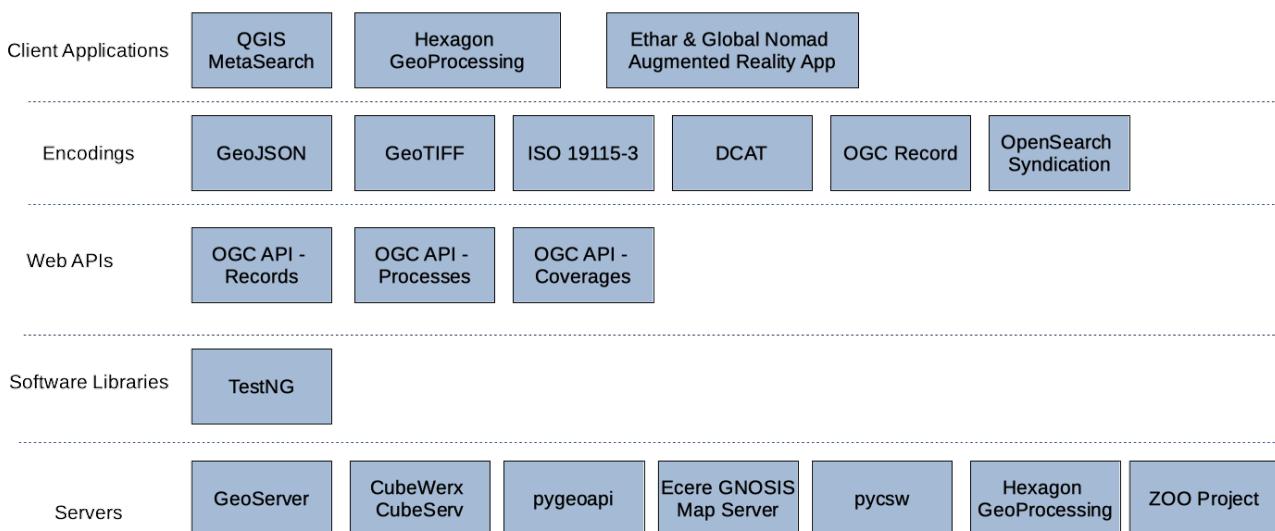


Figure 1. High level overview of the architecture implemented during the sprint

As illustrated, the sprint architecture was designed with the view of enabling client applications to connect to different servers that implement OGC APIs. The servers were provisioned with metadata, implementations of algorithms for geospatial analysis, vector feature data, and coverages such as satellite imagery.

6.2. Candidate Standards

6.2.1. OGC API - Processes

The draft OGC API - Processes specification defines an interface that enables the execution of geospatial computing processes and the retrieval of metadata describing their purpose and functionality. Typically, these processes execute implementations of well-defined algorithms that ingest vector and/or coverage data to produce new datasets or analytical products.

6.2.2. OGC API - Records

The draft OGC API - Records specification defines an interface that enables discovery and access to metadata records about resources such as features, coverages, tiles / maps, models, assets, services or widgets. The draft specification enables the discovery of geospatial resources by

standardizing the way collections of descriptive information about the resources (metadata) are exposed and accessed.

6.2.3. OGC API - Coverages

The draft OGC API - Coverages specification defines an interface that enables access to coverages that are modeled according to the Coverage Implementation Schema (CIS) 1.1. Coverages are represented by some binary or ASCII serialization, specified by some data (encoding) format. Arguably the most popular type of coverage is that of a gridded coverage. Gridded coverages have a grid as their domain set describing the direct positions in multi-dimensional coordinate space, depending on the type of grid. Satellite imagery is typically modeled as a gridded coverage, for example.

Chapter 7. Results

Multiple organizations provided servers, API implementations, and capabilities during the event. The rest of this section describes each of the implementations.

7.1. Augmented Reality Application

Developers from Ethar Inc and Global Nomad took part in the code sprint, extending an Augmented Reality (AR) application that they are building for Testbed-17. The AR application, which runs on a smartphone, allows a coverage such as one representing a Digital Elevation Model (DEM), to be visualized in a three-dimensional AR view as shown in Figure 2. This facilitates 'tabletop' visualization so that a group of people could potentially stand around a table and see geographic representation superimposed onto that table, with the DEM viewed either through smart glasses or a smartphone. The AR application can ingest coverages encoded in GeoTIFF format, therefore the application could be served by an implementation of OGC API - Coverages.

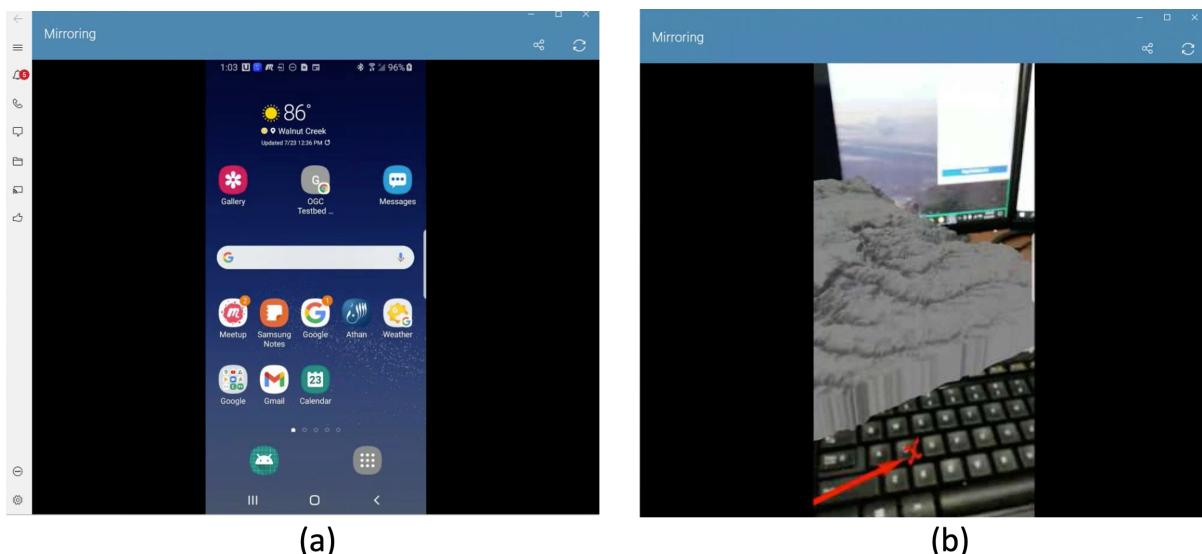


Figure 2. Screenshots of a smartphone mirrored (a) at standby (b) with the augmented reality application running

7.2. CubeWerx CubeSERV

The CubeWerx server ("CubeSERV") supports a wide variety of back-ends including Oracle Database, MariaDB, Shapefiles, etc. It also supports a wide array of service-dependent output formats (e.g. GML, GeoJSON, Mapbox Vector Tiles, MapMP, etc.) and coordinate reference systems. During this code sprint, CubeWerx helped fine-tune and mature several aspects of the OGC API specifications in focus for the sprint, and refined CubeSERV accordingly. CubeSERV supports multiple OGC API specifications.

The CubeSERV implementation of OGC API - Processes was configured to demonstrate a Ship

Detection capability, identifying ships from **RADARSAT** [<https://www.asc-csa.gc.ca/eng/satellites/radarsat2/Default.asp>] imagery. This was achieved by executing the analytical process on multiple nodes running in different Public Cloud regions (i.e. one in North America and another in Europe). **Figure 3** shows a view of the different nodes, running in different Cloud regions and used to detect the ships. The different nodes communicated through interfaces that conform to OGC API - Processes.

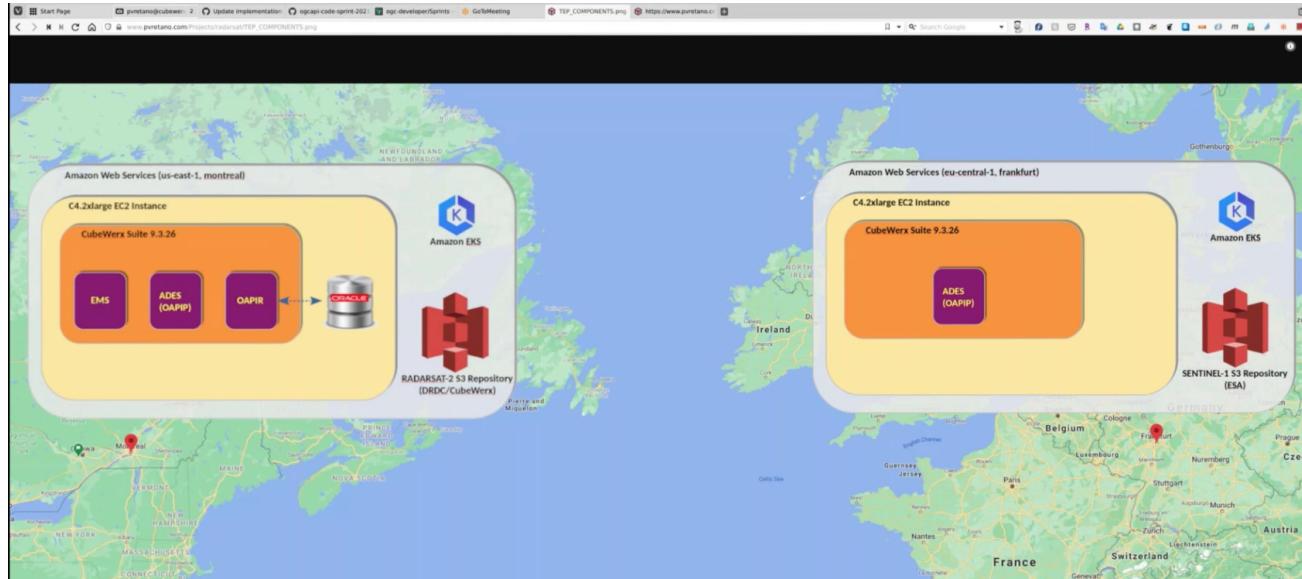


Figure 3. Screenshot from a demonstration of CubeSERV

Once a processing job running in CubeSERV has completed the outputs are made available for display on a web portal. In the case of Ship Detection, the location of ships was displayed as shown in **Figure 4**.

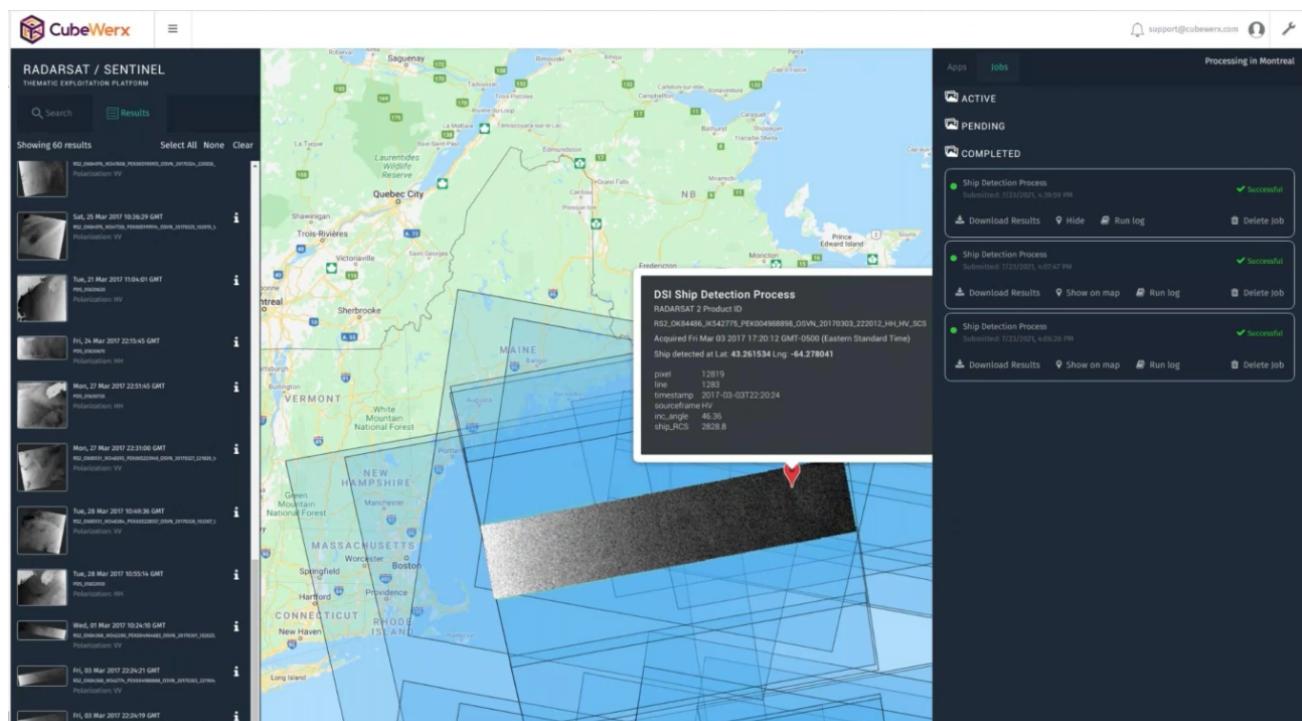


Figure 4. A second screenshot from a demonstration of CubeSERV

The CubeSERV implementation of OGC API - Records was configured to support discussion and

validation of the specification, whereas the OGC API - Coverages implementation facilitated development of compliance tests during the code sprint.

7.3. ZOO Project

Developers from Geolabs deployed an instance of ZOO Project, an open source platform written in C that implements a number of interface standards for geospatial processing, including OGC API - Processes and multiple versions of the WPS standard. The ZOO Project instance deployed for the code sprint offered wrappers around libraries such as the Orfeo Toolbox (OTB) and software such as GRASS GIS and SAGA GIS. This meant that through the OGC API - Processes interface, a client application could invoke the processing and analytical functions offered by these software packages. A screenshot of a landing page from a Geolabs ZOO Project instance is shown in [Figure 5](#).

The screenshot shows a web browser window with the URL tb17.geolabs.fr:8097/ogc-api/index.html. The title bar says "Non sécurisé | tb17.geolabs.fr:8097/ogc-api/index.html". The page content is as follows:

GeoLabs Home

The ZOO-Project OGC API - Processes Prototype Server

Prototype version of the ZOO-Project OGC API - Processes made available for the TestBed17. See <http://www.zoo-project.org> for more informations about the ZOO-Project.

WPS **GIS** **buffer**

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this document

[View this document in JSON](#).

[View the alternative version in HTML](#).

the API definition

[View the service description](#).

[View service documentation](#).

OGC API - Processes conformance classes implemented by this server

[View the specifications that the link's context conforms to](#).

[View the alternative version in HTML](#).

The processes offered by this server

[View the list of processes the API offers](#).

[View the alternative version in HTML](#).

Job Management

[View default \(no title found for canonical\)](#).

[View the alternative version in HTML](#).

{
 "title": "The ZOO-Project OGC API - Processes Prototype Server",
 "description": "Prototype version of the ZOO-Project OGC API - Processes made available for the TestBed17. See <http://www.zoo-project.org> for more informations about the ZOO-Project.",
 "links": [
 {
 "rel": "self",
 "type": "application/json",
 "title": "this document",
 "href": "http://tb17.geolabs.fr:8097/ogc-api/"
 }, {
 "rel": "root",
 "type": "application/json",
 "title": "the API definition",
 "href": "http://tb17.geolabs.fr:8097/ogc-api/index.html"
 }
],
 "processes": [
 {
 "process": "Buffer",
 "version": "1.0",
 "methods": [
 {
 "name": "Buffer",
 "parameters": [{"name": "rings", "type": "float"}, {"name": "distance", "type": "float"}],
 "examples": [{"name": "Buffer", "parameters": [{"rings": 1, "distance": 1}], "result": "Buffered geometry"}]
]
 }, {
 "process": "WPS",
 "version": "1.0",
 "methods": [
 {
 "name": "ProcessExecution",
 "parameters": [{"name": "process_id", "type": "string"}, {"name": "inputs", "type": "list"}, {"name": "outputs", "type": "list"}],
 "examples": [{"name": "ProcessExecution", "parameters": [{"process_id": "Buffer", "inputs": [{"rings": 1, "distance": 1}], "outputs": [{"name": "buffered_geometry", "type": "geometry"}]}], "result": "Completed process execution"}]
]
 }
]
}

Figure 5. A landing page from a Geolabs ZOO Project instance

A screenshot of a request and response from a completed processing job executed on ZOO Project is shown in [Figure 6](#).

The screenshot shows a web interface for a processing job titled "Pythagoras' Tree". On the left, there's a sidebar with "Execution options" like Subscribers, Response, and Mode, with a "Submit" button. Below it is the "Execute End Point" section. The main area displays a JSON-like "Your request" message and its corresponding "Your response". The "Your response" message includes fields for subscriber URLs (success, in-progress, failed), a result URL, and a type. At the bottom right are "Close" and "Submit Job" buttons.

```

{
  "id": "SAGA.garden_fractals.1",
  "title": "Pythagoras' Tree",
  "description": "Pythagoras' Tree.",
  "version": "1.0.0",
  "jobControlOptions": ["sync-execute", "async-execute", "dismiss"],
  "outputTransmission": ["value", "reference"],
  "links": [
    {
      "rel": "execute",
      "type": "application/json",
      "title": "Execute End Point",
      "href": "http://tb17.geolabs.fr:8097/ogc-api/processes/SAGA.garden_fractals.1/execution"
    }
  ]
}

```

http://tb17.geolabs.fr:8097/ogc-api/processes/SAGA.garden_fractals.1.html
Last modified: Wed Jul 21 16:36:03 CEST 2021
Powered by ZOO-Project 1.8.1-dev .

Figure 6. A request and response from a completed processing job executed on ZOO Project

7.4. GeoServer

GeoSolutions deployed an instance of the GeoServer product. GeoServer is a Java-based software server that allows users to view and edit geospatial data. GeoServer supports multiple OGC API specifications. For this code sprint, the server was configured to offer an endpoint supporting multiple conformance classes and recommendations from the draft OGC API - Coverages - Part 1: Core specification. The development focused on updating GeoServer's implementation of the OGC API - Coverages specification to the latest draft version of the specification, building on GeoServer's existing support for the Web Coverage Service (WCS) standard.

The screenshot shows the GeoServer Coverage services landing page. At the top, there's a header with navigation icons and the URL 'gs-main.geosolutionsgroup.com/geoserver/ogc/coverages'. Below the header is the GeoServer logo. A main title 'Coverage services' is centered above three rectangular boxes. The first box contains 'API definition' information, the second contains 'Collections' information, and the third contains 'Conformance' information. Below these boxes is a section titled 'Contact information' with a bulleted list of details.

Figure 7. The landing page of the OGC API - Coverages implementation of GeoServer

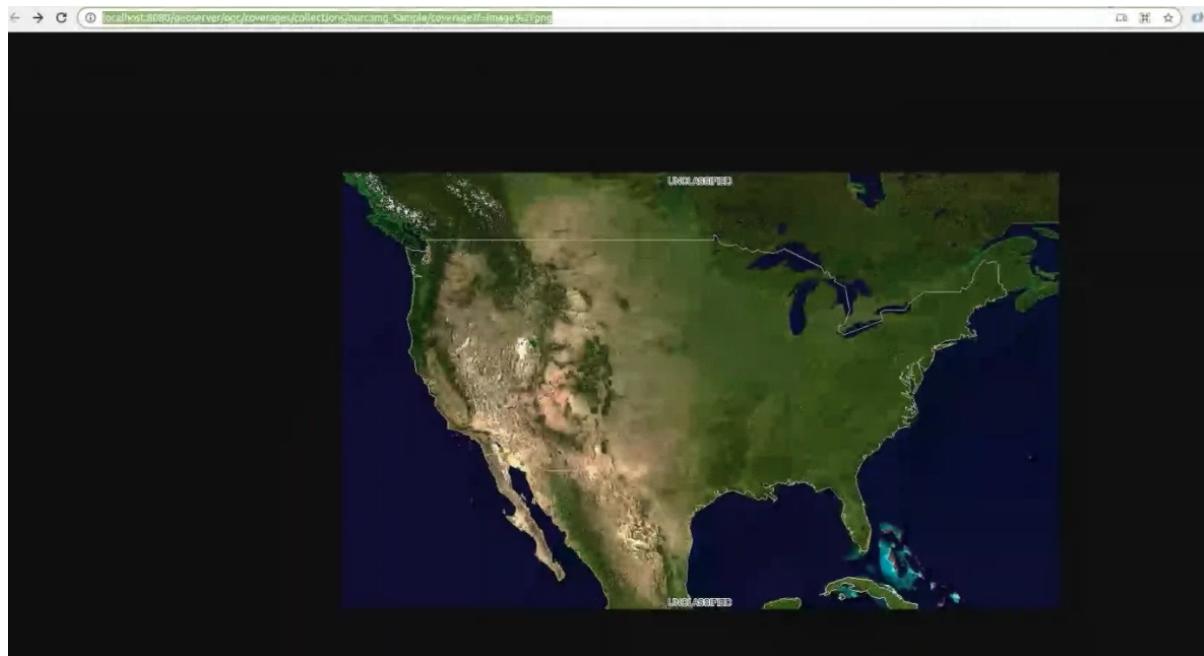


Figure 8. A coverage retrieved from the OGC API - Coverages implementation of GeoServer

7.5. Ecere GNOSIS Map Server

The GNOSIS Map Server is written in the eC programming language and supports multiple OGC API specifications. The API allows for retrieval of coverages, maps and tiles (both coverage and map tiles) of a dataset. Ecere configured the server to offer coverages through an interface conforming to OGC API - Coverages. Multiple encodings are supported including GNOSIS Map Tiles (which can contain either vector data, gridded coverages, imagery, point clouds or 3D meshes), GeoTIFF, GeoJSON, Mapbox Vector Tiles and MapML. For this code sprint, the server was used in support of the development of compliance tests.

7.6. Hexagon Geoprocessing Suite

Developers from Hexagon took part in the code sprint, focusing on the OGC API - Processes candidate standard. The developers configured the Hexagon Geoprocessing Suite, which includes a number of Hexagon products, to offer a variety of image analysis capabilities. The suite includes ERDAS APOLLO, which provides an end-to-end workflow to execute algorithms that operate on geospatial data. The algorithms were exposed as processes through an interface conforming to OGC API - Processes. The suite also includes ERDAS IMAGINE, a software product for image analysis and processing. The workflows were designed using the Spatial Model Editor from ERDAS IMAGINE product, a screenshot of which is shown in [Figure 9](#).

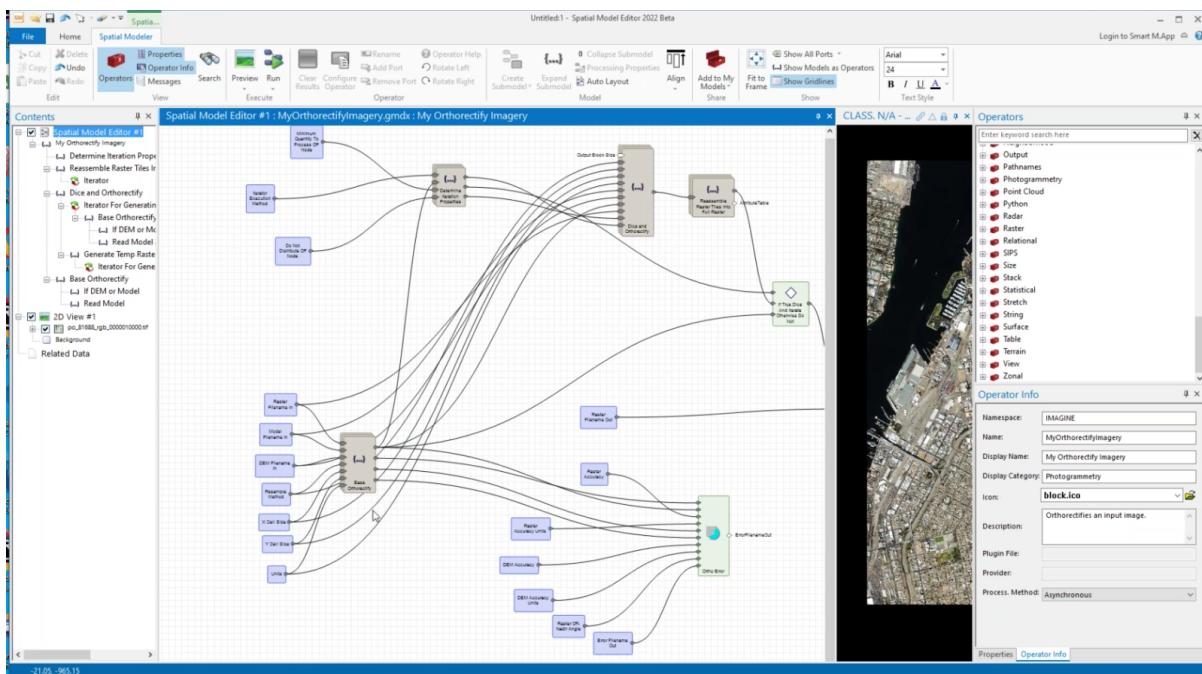


Figure 9. A screenshot of a workflow designed using Hexagon's Spatial Model Editor

ERDAS IMAGINE allows geospatial analysts to create custom models and to publish the models to the ERDAS APOLLO catalog, from where they can be executed by end-users as illustrated in [Figure 10](#). While each processing job is running, an administrator can monitor the jobs through a status view as shown in [Figure 11](#). This capability demonstrated the ability of OGC API - Processes to support both synchronous and asynchronous execution modes.

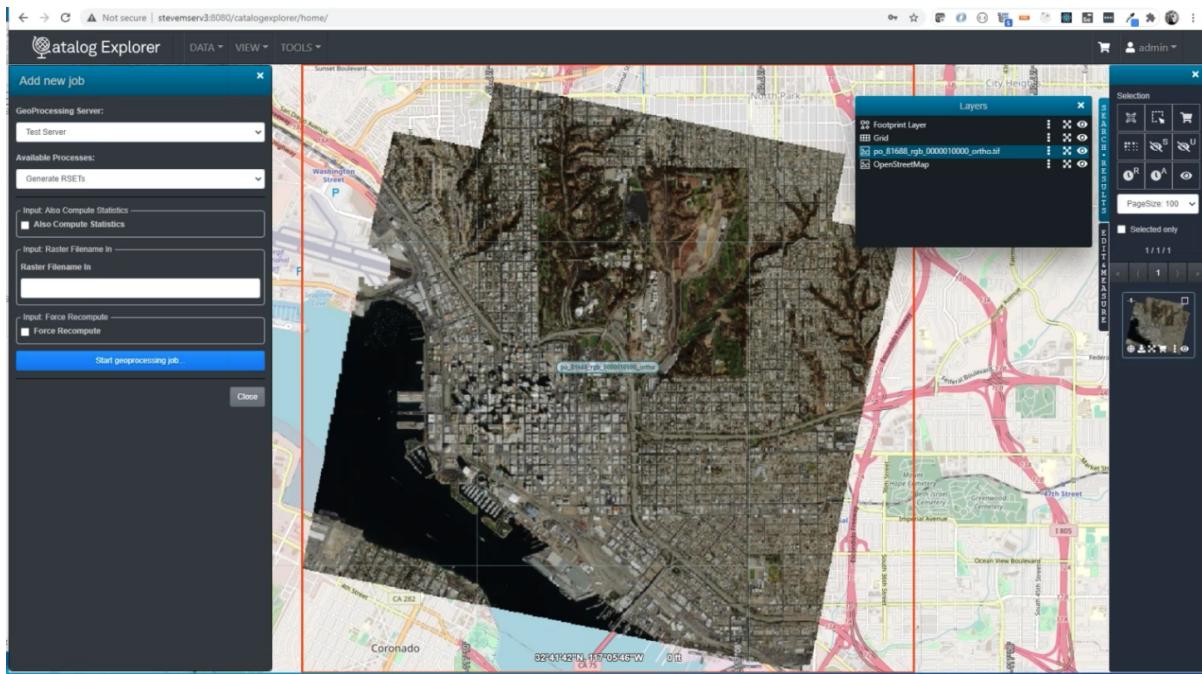


Figure 10. A screenshot of the output of a completed processing job in Hexagon Geoprocessing suite

JOBS		WORKERS		PROCESSES							
Geoprocessing Jobs				Submitted date		Completed date		Auto refresh		Search	
Actions	Job ID	Process	Step	Step Worker Node	Progress	Submitted	Status	Duration	Processing Start	Processing End	Outcome
	eed52e51-56e8-448d-a1ca-e5a2de4cad9	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 9:11:43 AM	successful	16 seconds	7/23/2021 9:11:43 AM	7/23/2021 9:11:59 AM	
	866656441-c3ae-4b55-97e9-590e8782f2f	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 8:55:28 AM	successful	15 seconds	7/23/2021 8:55:28 AM	7/23/2021 8:55:43 AM	
	f4c19e5a-812d-4a41-8ceb-35cc88555267	MyOrthorectifyImagery		pmw5520	<div style="width: 0%; background-color: #ccc;">0%</div>	7/23/2021 8:52:04 AM	failed	5 seconds	7/23/2021 8:52:04 AM	7/23/2021 8:52:09 AM	
	5092848c-a251-4d27-a75f-8992c2659d74	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 8:20:12 AM	successful	15 seconds	7/23/2021 8:20:12 AM	7/23/2021 8:20:27 AM	
	721e9c2d-18a7-4409-8d26-874752d64fb0	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 2:40:59 PM	successful	10 seconds	7/23/2021 2:40:59 PM	7/23/2021 2:41:09 PM	
	c8945276-48bb-4e2e-ae23-6faecb4771e4	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 2:11:56 PM	successful	10 seconds	7/23/2021 2:11:56 PM	7/23/2021 2:12:06 PM	
	bcd85744-3d56-4021-9f4a-2bcbab5f0bd0	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 11:48:50 AM	successful	10 seconds	7/23/2021 11:48:50 AM	7/23/2021 11:49:00 AM	
	47a310f-f097-4421-95a8-560e4a1fd17f	MyOrthorectifyImagery		pmw5520	<div style="width: 100%;">100%</div>	7/23/2021 11:11:50 AM	successful	10 seconds	7/23/2021 11:11:50 AM	7/23/2021 11:12:00 AM	

Figure 11. A screenshot of an overview of the status of processing jobs in Hexagon Geoprocessing suite

7.7. QGIS MetaSearch Plugin

During the code sprint, developers from OSGeo, Meteorological Service of Canada (MSC) and GeoCat BV worked on an enhancement to the QGIS MetaSearch plugin to improve support for OGC API - Records. MetaSearch is a core plugin that enables QGIS to act as a client application for interacting with metadata catalogue services. A screenshot of the search dialog window of the QGIS MetaSearch plugin is shown in Figure 12.

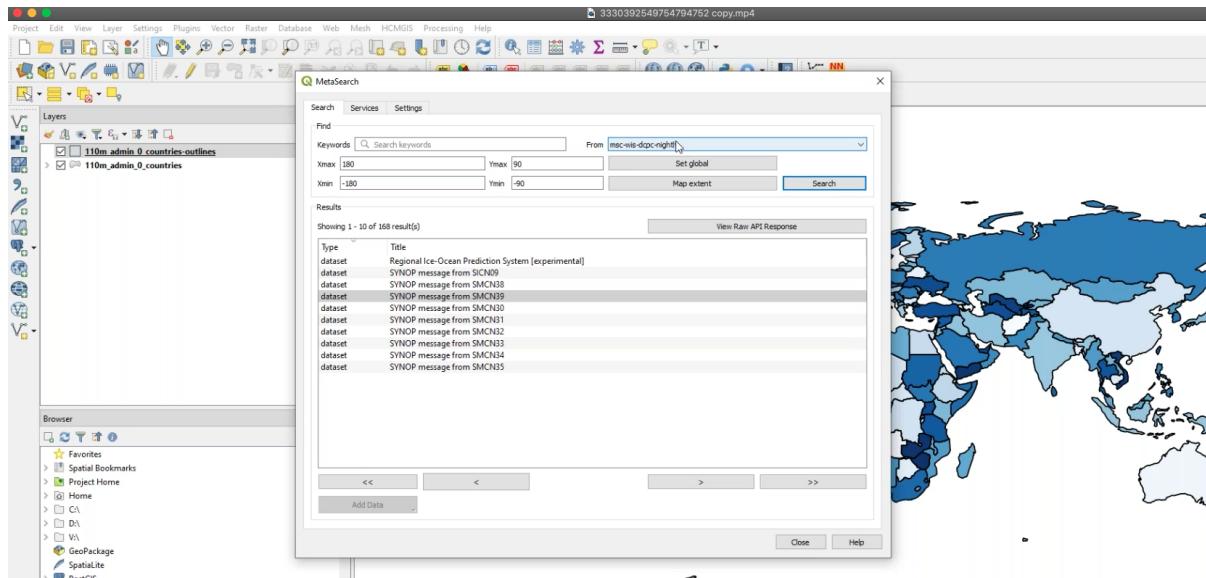


Figure 12. The search dialog window of the QGIS MetaSearch plugin

A screenshot of the metadata view window of the QGIS MetaSearch plugin is shown in Figure 13.

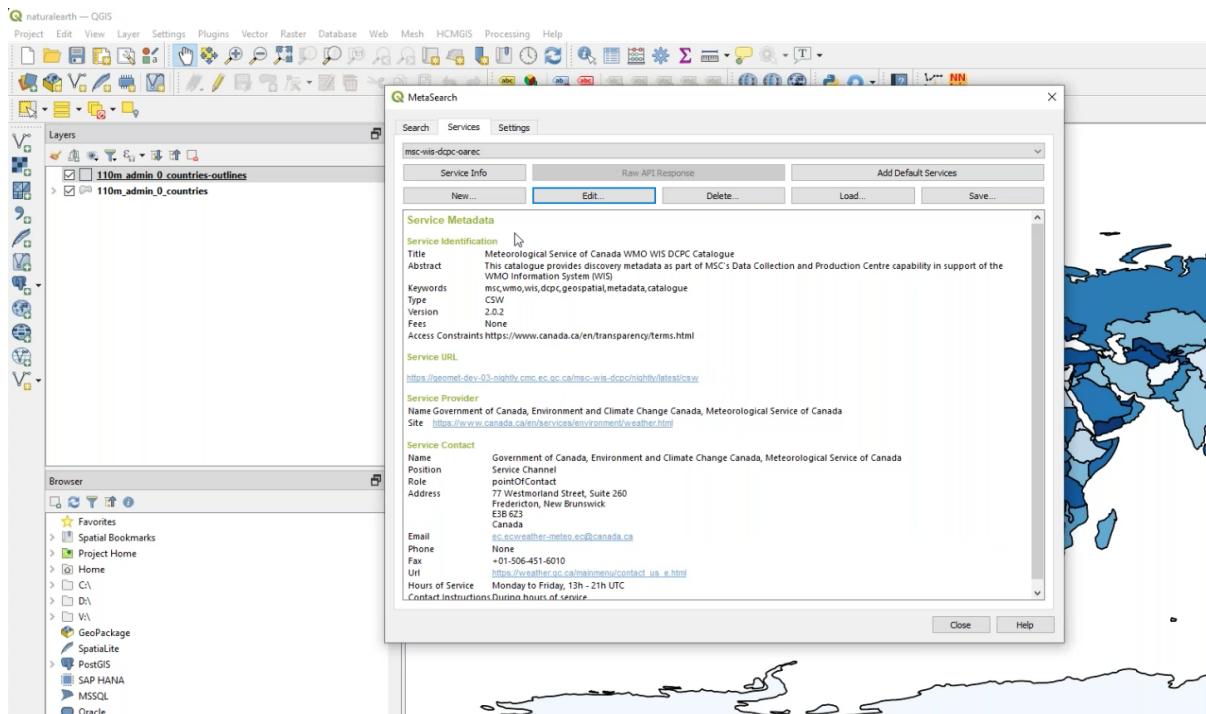


Figure 13. The metadata view window of the QGIS MetaSearch plugin

Another screenshot of the QGIS MetaSearch plugin windows is shown in Figure 14.

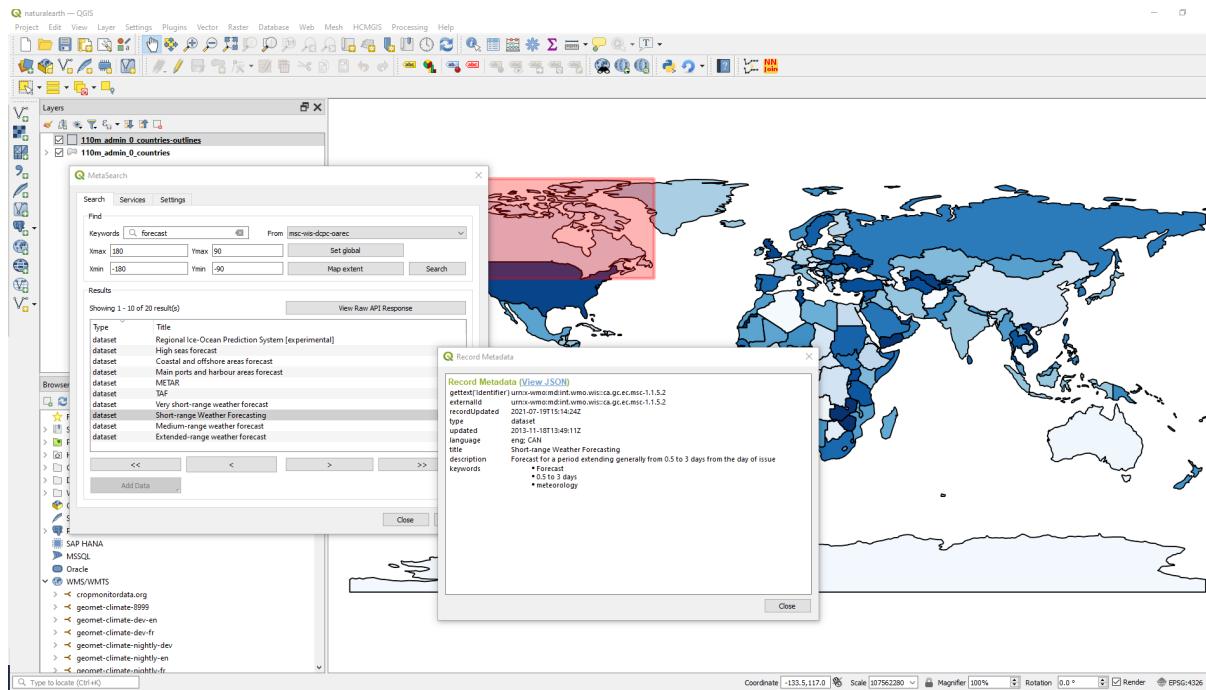


Figure 14. Another screenshot of the QGIS MetaSearch plugin windows

As a result of the work done during the code sprint, QGIS MetaSearch now supports both OGC CSW and OGC API - Records. The functionality is currently in a development branch and will be added to the primary branch of QGIS in fall 2021.

7.8. Mappings between ISO 19115-3 and OGC API - Records Queryables

Developers from OpenWork took part in the code sprint, with focus on metadata and the [OpenSearch Syndication Protocol](https://github.com/dewitt/opensearch) [<https://github.com/dewitt/opensearch>] [1]. The work on metadata involved designing mappings between the 'queryables' model implemented by OGC API - Records and [ISO/TS 19115-3:2016](https://www.iso.org/standard/32579.html) [<https://www.iso.org/standard/32579.html>], an integrated XML implementation of the metadata standards ISO 19115-1, ISO 19115-2, and concepts from ISO/TS 19139. For this code sprint the mappings focused on associations between OGC API - Records and ISO 19115-1 metadata elements. The mappings have been archived on the sprint's [GitHub repository](https://github.com/opengeospatial/ogcapi-code-sprint-2021-07/blob/main/mappings/ISO19115-3_Mappings.md) [https://github.com/opengeospatial/ogcapi-code-sprint-2021-07/blob/main/mappings/ISO19115-3_Mappings.md] and are presented in [Appendix B](#).

7.9. OpenSearch Syndication Protocol

Some of the prototyping by developers from OpenWork involved implementation of an OpenSearch description document. The OpenSearch description document is used to describe a search engine so that it can be used by search client applications. Once configured on an OpenSearch client (ideally a web browser), the search engine becomes accessible as illustrated on [Figure 15](#).



Figure 15. The landing page of a search engine's user interface

A screenshot of search results retrieved through OpenSearch Syndication is shown in [Figure 16](#).

- [**NZ Orthophotos 1995-1996**](#)

<p>LINZ publishes 1:25,000 scale orthophotos of New Zealand from its archive. The New Zealand orthophotos shown are historical and no further orthophotos of New Zealand will be published. Coverage of 1 pixel is 2.5m x 2.5m
</p><br clear="all"/>

From:
- [**NZ Orthophotos 1995-1996**](#)

<p>LINZ publishes 1:25,000 scale orthophotos of New Zealand from its archive. The New Zealand orthophotos shown are historical and no further orthophotos of New Zealand will be published. Coverage of 1 pixel is 2.5m x 2.5m
</p><br clear="all"/>

From:
- [**NZ Orthophotos 1997-1998**](#)

<p>LINZ publishes 1:25,000 scale orthophotos of New Zealand from its archive. The New Zealand orthophotos shown are historical and no further orthophotos of New Zealand will be published. Coverage of 1 pixel is 2.5m x 2.5m
</p><br clear="all"/>

From:
- [**NZ Orthophotos 1997-1998**](#)

<p>LINZ publishes 1:25,000 scale orthophotos of New Zealand from its archive. The New Zealand orthophotos shown are historical and no further orthophotos of New Zealand will be published. Coverage of 1 pixel is 2.5m x 2.5m
</p><br clear="all"/>

From:

Figure 16. A screenshot of search results retrieved through OpenSearch Syndication.

7.10. pycsw

During the code sprint, developers from the Open Source Geospatial Foundation (OSGeo) deployed an instance of [pycsw](https://pycsw.org) [<https://pycsw.org>], an open source server-side Python implementation of the OGC Catalogue Services for the Web (CSW) standard. The pycsw software product allows for the publishing and discovery of geospatial metadata via numerous APIs (CSW 2.0.2, CSW 3.0.0, OpenSearch Syndication Protocol, and others), providing a standards-based metadata and catalogue component of spatial data infrastructures. OSGeo developers participating in the code sprint extended the pycsw code base to include support for OGC API - Records, as well as the [SpatioTemporal Asset Catalog \(STAC\)](https://stacspec.org) [<https://stacspec.org>] [2]. A screenshot of the landing page of one of the pycsw instances is shown in [Figure 17](#).

pycsw Geospatial Catalogue

Home JSON | Contact

pycsw is an OGC CSW server implementation written in Python

Collections
OpenAPI
Swagger
JSON
Conformance
CSW 3.0.0
CSW 2.0.2
OpenSearch
QAI-PMH
SRU

Powered by pycsw 3.0.dev0

Figure 17. The landing page of one of the pycsw instances

A screenshot of a series of metadata records from a collection accessed on an instance of pycsw is shown in Figure 18.

Home / Collections / pycsw Geospatial Catalogue / Items

Prev Next

Title	Type
S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34SDJ_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34SDH_20200930T105731.SAFE	dataset
Sentinel-2 MSI	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34SEJ_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T35SKC_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34TDK_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34TFL_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T34TEK_20200930T105731.SAFE	dataset
S2A_MSIL1C_20200930T092031_N0209_R093_T35TKF_20200930T105731.SAFE	dataset

Powered by pycsw 3.0.dev0

Figure 18. A series of metadata records from a collection accessed on an instance of pycsw

A screenshot of a single metadata record from an instance of pycsw is shown in Figure 19.

The screenshot shows a web-based geospatial catalogue interface. At the top, there's a header with a logo, a URL, and some icons. Below the header, the title "pycsw Geospatial Catalogue" is displayed. A breadcrumb navigation bar shows "Home / Collections / pycsw Geospatial Catalogue / Items / S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE". On the right, there are links for "JSON | Contact". The main content area is titled "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE". It features a map with a blue rectangle indicating the dataset's spatial extent. To the right is a table with the following data:

Property	Value
externalId	S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE
recordUpdated	2021-04-19T13:34:16Z
type	dataset
created	2020-09-30T10:57:31.000000Z
updated	2020-09-30T10:57:31.000000Z
title	S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE
description	S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE
keywords	['Orthoimagery', 'Land cover', 'Geographical names', 'data set series', 'processing', 'eo:productType:/', 'eo:orbitNumber:/', 'eo:orbitDirection:/', 'eo:processingLevel:Level-1C']
extents	{'spatial': {'bbox': [[19.88, 36.06, 21.11, 37.04]], 'crs': 'http://www.opengis.net/def/crs/OGC/1.3/CRS84'}}

At the bottom left, it says "Powered by pycsw 3.0.dev0".

Figure 19. A single metadata record from an instance of pycsw

7.11. pygeoapi

A number of sprint participants deployed instances of [pygeoapi](https://pygeoapi.io) [<https://pygeoapi.io>] and worked collaboratively to enhance the software's support for various OGC APIs. Participants working on pygeoapi included developers from OSGeo, MSC, 52°North, GeoCat BV and Geobeyond Srl. The pygeoapi software product is an open source Python server implementation of the OGC API suite of standards. The product supports the microservices approach and allows for scalability and cloud friendly deployment.

7.11.1. Accessing metadata records

Developers from MSC, OSGeo, GeoCat BV and Geobeyond Srl configured an instance of pygeoapi to enable access to metadata records. A screenshot of the landing page of one of the pygeoapi instances is shown in [Figure 20](#).

The screenshot shows the landing page of a pygeoapi instance. At the top, there's a header with the pygeoapi logo and a 'Contact' link. Below the header, the title 'pygeoapi Demo instance - running latest GitHub version' is displayed. A sub-header states 'pygeoapi provides an API to geospatial data'. There are three buttons: 'geospatial', 'data', and 'api'. Below these are links for 'Terms of service' (pointing to <https://creativecommons.org/licenses/by/4.0>) and 'License' (CC-BY 4.0 license). The main content area is divided into several sections: 'Collections', 'SpatioTemporal Assets', 'Processes', 'API Definition', 'Conformance', and 'Provider'. The 'Provider' section contains contact information: 'pygeoapi Development Team' with a link to <https://pygeoapi.io>. The 'Contact point' section includes fields for 'Address', 'Email', 'Telephone', 'Fax', 'Contact URL', 'Hours', and 'Contact instructions'. At the bottom, it says 'Powered by pygeoapi 0.11.dev0'.

Figure 20. The landing page of one of the pygeoapi instances

A screenshot of an overview of one of the collections of metadata records offered by one of the pygeoapi instances is shown in [Figure 21](#).

The screenshot shows the collection overview page for 'dutch-metadata'. At the top, there's a header with the pygeoapi logo and a 'Contact' link. Below the header, there's a large map of Europe with a blue box highlighting a region in the Netherlands and Germany. To the right of the map, there's a sidebar with sections for 'Browse' (listing items from the Dutch National Georegister), 'Queryables' (listing queryables from the same source), and 'Links' (listing various formats and links for the collection). At the bottom, it says 'Powered by pygeoapi 0.11.dev0'.

Figure 21. An overview of one of the collections of metadata records offered by one of the pygeoapi instances

7.11.2. Accessing processes

Developers from MSC, OSGeo, GeoCat BV and Geobeyond Srl configured an instance of pygeoapi to enable access to processes through an interface conforming to OGC API - Processes. A screenshot of a rendering of the API definition of one of the processes is shown in [Figure 22](#). The

pygeoapi code base was updated to support the latest changes in the OGC API - Processes specification.

The screenshot shows a detailed API definition for a process named "hello-world". It includes sections for GET and POST methods, parameters, request body, and a JSON example. The "Parameters" section shows a single parameter "response_string" with a dropdown menu set to "document". The "Request body" section is marked as required and contains a JSON schema example:

```
{
  "inputs": {
    "message": "An optional message.",
    "name": "World"
  }
}
```

Figure 22. A screenshot of a rendering of the API definition of one of the processes

7.11.3. Accessing coverages

Developers from 52°North configured an instance of pygeoapi to enable access to Data Cubes, initially deployed for Testbed-17. A screenshot of the pygeoapi interface from the 52°North Data Cube demonstration is shown in Figure 23.

The screenshot shows the pygeoapi interface for a Data Cube. At the top, there's a map of the Great Lakes and surrounding regions. Below the map, a table lists eight coverage items with the following data:

id	id	name	description	creation_time
dsmCHS_M...	4	dsmCHS_MB_The...	"dsmCHS" data created by "MB" ...	None
dsmCHS_N...	7	dsmCHS_NRCAN_E...	"dsmCHS" data created by ...	None
dsmCHS_N...	1	dsmCHS_NS_Port_...	"dsmCHS" data created by "NS" ...	None
dsm_MB_...	5	dsm_MB_The_Pas...	"dsm" data created by "MB" ...	None
dsm_NRCA...	8	dsm_NRCAN_Edmo...	"dsm" data created by "NRCA..."	None
dsm_NS_...	2	dsm_NS_Port_Haw...	"dsm" data created by "NS" ...	None
dtm_MB_...	6	dtm_MB_The_Pas...	"dtm" data created by "MB" ...	None
dtm_NRCA...	9	dtm_NRCAN_Edmo...	"dtm" data created by "NRCA..."	None
dtm_NS_...	3	dtm_NS_Port_Haw...	"dtm" data created by "NS" ...	None

Figure 23. Screenshot of pygeoapi interface from the 52°North Data Cube demonstration

Once coverages from the Data Cube are published through the pygeoapi, they can be accessed through the OGC API - Coverages interface and displayed on a client application such as QGIS. A coverage displayed using QGIS after download from the Data Cube is shown in Figure 24.

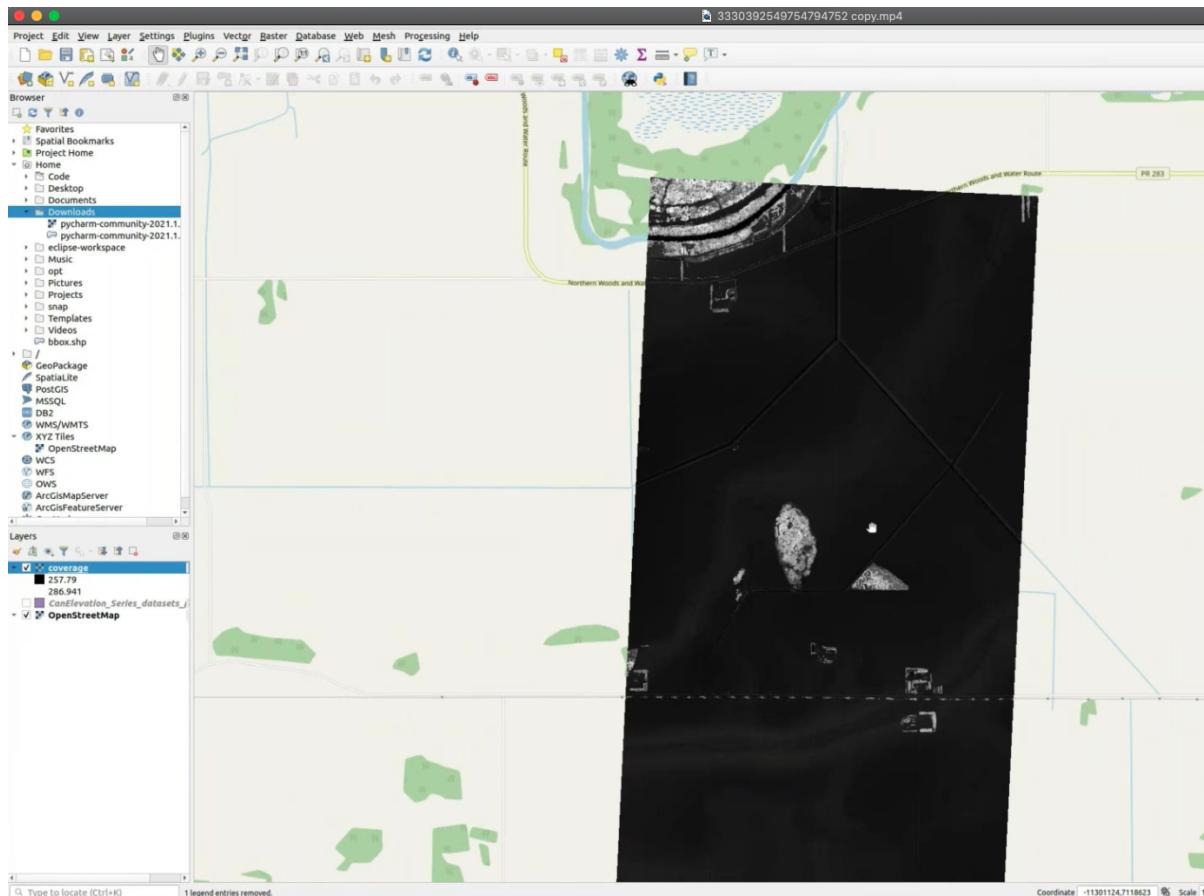


Figure 24. Coverage displayed using QGIS after download from the 52°North Data Cube supplied using pygeoapi

7.12. Other Outputs

Other developments and software deployments during the code sprint are described in the following sections.

7.12.1. Documentation

- A [draft user guide](https://github.com/opengeospatial/ogcapi-code-sprint-2021-07/tree/main/Draft_Spring_Guide_for_OGC_API_Proceses) [https://github.com/opengeospatial/ogcapi-code-sprint-2021-07/tree/main/Draft_Spring_Guide_for_OGC_API_Proceses] was developed for software developers that use the [Spring Framework](https://spring.io/projects/spring-framework) [<https://spring.io/projects/spring-framework>] to build implementations of OGC API - Processes. The Spring Framework is an open source application framework and inversion-of-control container for the Java Platform. The user guide developed during the code sprint made use of Spring along with OpenAPI Tools Generator.

Chapter 8. Discussion

This section provides a summary of the discussion.

8.1. Potential relationship between STAC and OGC API - Records

The sprint participants discussed the potential relationship between STAC and OGC API - Records, in order to identify opportunities for alignment. This subsection summarizes that discussion.

The sprint participants noted that there had been previous discussions between OGC staff and the STAC community about the possibility of bringing the STAC API into the OGC's standardization process. This was partly because the STAC API is an extension of OGC API - Features - Part 1: Core. The current thinking is to submit STAC into the standardization process as a candidate OGC Community Standard. That would require STAC to be stable, at version 1.0 at least.

Some of the opportunities for alignment between STAC and OGC API - Records are static equivalents for Collections and Records. The sprint participants noted that, in a previous discussion, there was an observation that there is a need for a 'Dataset Record'. A 'Record' would be a flexible and generic concept, whereas a Dataset Record would represent dataset metadata such as in the context of ISO 19115. The grouping would be the Collection. With these concepts in place, it would potentially be possible to have STAC as a Record or an extension of OGC API - Records.

The sprint participants noted that in OGC API - Records, in contrast to STAC, the actual Record description is distinct from the API. The Record description is loosely bound to the API in OGC API - Records. For example, there is no requirement for the record to be encoded in GeoJSON as other encodings (e.g. ATOM) are allowed. The Record is also not bound to a particular dataset or asset. There is an expectation that developers would take the Record and enrich the content to suit specific needs. There was an observation made that it would benefit developers to extract the description of the Record content model and make it more standalone on either the specification document as a building block or in an accompanying document such as a user guide.

What is the distinction between the STAC Catalog and the STAC Collections specifications? The STAC Catalog is a JSON file of links that provides a structure to organize and browse STAC Items. The STAC Collection is an extension of the STAC Catalog with additional information that describes STAC Items that fall within the Collection. The STAC Catalog specification is therefore to an extent independent of the API. It is a structured concept that indicates "this links to more items". If you have millions of records, instead of placing them in a single collection, the catalog lets you break them up in arbitrary ways. The approach is based on OGC API - Features, and so a STAC Collection can be served as a Collection from an OGC API - Features implementation.

The Records API is to an extent consistent with the Features API. This suggests that the biggest

need is for the Dataset Collection, with the fields in the collection clearly defined. This is necessary because Collection is non-GeoJSON, whereas Record is GeoJSON. They should translate between each other easily. This could, for instance, lead to a static Features API involving a series of files in a Cloud Storage resource. The sprint participants observed that, from a Meteorological perspective, it would be useful to have a static API that provides access to a series of files.

STAC inherits from an OGC API - Features collection, but ideally the preference would be to inherit from a Dataset Collection. So potentially there could be two separate representations of the collection, at different levels of the API hierarchy, using an 'alternate' relation type to provide links to the two different representations.

The sprint participants recommended that Part 1 (the Core) be made generic and that the Dataset Collection conformance class be specified in Part 2. Support for datasets should be optional and could be based on ISO 19115-1, ISO 19115-2 and ISO 19115-3 metadata standards. This could then lead to a Part 3 that focuses on STAC. The work on STAC should not start until the Part 1 is stable.

There was also discussion about the structure of the Part 1 document, including whether some conformance classes (e.g. sort by) should be moved to OGC API - Features. This also included consideration of where a section describing the Collection could be placed in OGC API - Records - Part 1: Core. This capability would facilitate the creation of static catalogs. A static catalog would offer value to some user needs. Such a capability could have more utility and have wider uptake if included in OGC API - Features, and possibly in the long term it could be part of OGC API - Common. The capability could also be specified in OGC API - Records and still have utility in OGC API - Features. In OGC API - Features, by default, every API implementing the standard will provide access to a single dataset.

8.2. Should OGC API - Records support the OpenSearch Syndication Protocol?

The sprint participants discussed whether the OpenSearch Syndication Protocol is still being used and whether it is still relevant. The discussion was in part triggered by the migration of the OpenSearch Syndication Protocol from its previous home of opensearch.org to a [personal GitHub repository](https://github.com/dewitt/opensearch) [https://github.com/dewitt/opensearch]. OpenSearch is a registered trademark of Amazon and now has been repurposed to [refer](https://opensearch.org) [https://opensearch.org] to an open source search and analytics suite. To disambiguate between the two OpenSearch initiatives, an [explanatory web page](https://opensearch.org/disambiguation.html) [https://opensearch.org/disambiguation.html] has been created. Maintainers of the OpenSearch Syndication Protocol also provide [their own](https://github.com/dewitt/opensearch#how-is-it-related-to-the-opensearch-software-project) [https://github.com/dewitt/opensearch#how-is-it-related-to-the-opensearch-software-project] disambiguation. The sprint participants observed that, after supporting the OpenSearch Syndication Protocol for a number of years, the protocol was [no longer supported](https://blog.mozilla.org/addons/2019/10/15/search-engine-add-ons-to-be-removed-from-addons-mozilla-org/) [https://blog.mozilla.org/addons/2019/10/15/search-engine-add-ons-to-be-removed-from-addons-mozilla-org/] in add-ons of the Mozilla Firefox web browser.

The OpenSearch Syndication Protocol is referenced by a number of OGC Standards, namely [OGC® OpenSearch Geo and Time Extensions \(OGC 10-032\)](#) [https://portal.ogc.org/files/?artifact_id=56866],

OGC OpenSearch Extension for Earth Observation (OGC 13-026r9) [<http://docs.opengeospatial.org/is/13-026r9/13-026r9.html>], OGC OpenSearch-EO GeoJSON(-LD) Response Encoding Standard (OGC 17-047r1) [<https://docs.opengeospatial.org/is/17-047r1/17-047r1.html>], and OGC EO Dataset Metadata GeoJSON(-LD) Encoding Standard (17-003r2) [<https://docs.ogc.org/is/17-003r2/17-003r2.html>]. The OpenSearch Syndication Protocol defines an XML "description" format for search services to describe how to send them search queries. If the search service formats the results in RSS or ATOM the results from multiple services can be merged into a single listing. The protocol is actively used in the Earth Observation community, including at the European Space Agency (ESA) and the US National Aeronautics and Space Administration (NASA), possibly because another protocol has not emerged to fill this role.

The draft OGC API - Records - Part 1: Core standard currently includes a conformance class for the OpenSearch Syndication Protocol. The sprint participants recommended that the conformance class be removed out of the draft OGC API - Records - Part 1: Core standard and be considered for a future extension. Specifying the conformance class in a separate extension would allow the conformance class to be easily deprecated or renamed in the future without affecting the rest of OGC API - Records.

8.3. Coverage Processing in OGC API - Processes

There was a discussion to explore whether a new language could be developed to support the analysis of coverages in implementations of OGC API - Processes. Such a language would address similar needs to those addressed by the Web Coverage Processing Service (WCPS). There was concern that WCPS could be too complex to use, hence the need for a simpler alternative. Having a simpler alternative would allow client applications to specify the language that they are using in a request. The sprint participants noted that currently several products use raster algebra to support analysis and filtering, however, the products do not appear to share a common language for expressing the raster algebra.

The sprint participants expressed an interest in having a consistent syntax for expressions. The new language or syntax for describing coverage analysis would need to be able to access information about the coverage at multiple levels e.g. at coverage level, band level and at pixel level. The expressivity of the language was therefore identified as a key consideration, on a simplicity spectrum, a single link expression would be the easiest to implement but would be limited in its ability to express analysis. In contrast, a procedural language would be more expressive and allow the description of more complex analysis.

8.4. Supporting ISO 19115-1:2014 and ISO 19115:2003 in OGC API - Records

There are several organizations that have established infrastructure that relies on ISO 19115-1:2014, ISO 19115:2003 [<https://www.iso.org/standard/26020.html>] and their profiles. Examples of profiles of ISO 19115-1:2014 include NSG Metadata Foundation (NMF) [https://gwg.nga.mil/documents/NMF_v1_final.doc] and DGIWG Metadata Foundation (DMF) [<https://portal.dgiwg.org/files/67565>]. Examples of profiles of ISO 19115:2003 include the INSPIRE Metadata Implementing Rules [<https://inspire.ec.europa.eu/documents/inspire-metadata-implementing-rules-technical-guidelines-based-en>]

`iso-19115-and-en-iso-1]` and [ANZLIC Metadata Profile](https://www.anzlic.gov.au/sites/default/files/files/anzlic_metadata_profile_v1_1.pdf) [https://www.anzlic.gov.au/sites/default/files/files/anzlic_metadata_profile_v1_1.pdf]. (It should be noted that the ANZLIC profile of ISO19115 has been deprecated by ANZLIC and replaced by ISO19115-1:2014/Add-1:2118 and is seeing broad use.) The sprint participants noted that one of the challenges of the OGC API - Records SWG will be to design the API in such a way that allows for the publication of metadata encoded according to ISO 19115-1 or its profiles.

The sprint participants confirmed that OGC API - Records can return records representing metadata fields from ISO 19115-1:2014, which are encoded according to the schemas specified in [ISO/TS 19115-3:2016](https://www.iso.org/standard/32579.html) [<https://www.iso.org/standard/32579.html>]. Similarly, OGC API - Records can return records representing metadata fields from ISO 19115:2003, which are encoded according to the schemas specified in [ISO/TS 19139:2007](https://www.iso.org/standard/32557.html) [<https://www.iso.org/standard/32557.html>]. This is achieved through Content Negotiation. For example, the following GET request retrieves a JSON encoded metadata record from a pycsw instance deployed for the EO Exploitation Platform Common Architecture (EOEPCA). The response is as shown in [Appendix A.1](#).

https://resource-catalogue.demo.eoepca.org/collections/metadata:main/items/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE?f=json

The same metadata record can be retrieved encoded in XML conforming to ISO 19115-3 through the request below. The response is as shown in [Appendix A.2](#).

https://resource-catalogue.demo.eoepca.org/collections/metadata:main/items/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE?f=xml

The examples above highlight that one of the reasons why the Records API has a Record model is to allow an implementation of OGC API - Records to query across any metadata standard that can be mapped to the Record model. If a data publisher has a catalogue that is based on ISO 19115-3, then all they need to do is to map their schema to the model in OGC API - Records. Another option is to make a mapping between ISO to the Record model in OGC API - Records. An example of such a mapping was developed during the code sprint and is available on the sprint's [GitHub repository](#) [https://github.com/opengeospatial/ogcapi-code-sprint-2021-07/blob/main/mappings/ISO19115-3_Mappings.md] and is also presented in [Appendix B](#). As the example listings shown above indicate, there is a need to specify which XML profile to retrieve the metadata in. This is something that could be proposed as a new conformance class in a new OGC API - Records extension or profile standard. The Content Negotiation mechanism would be designed to allow the use of the [profile](#) mechanism in media types or a [schema](#) query parameter to identify the schema to use.

The sprint participants also noted that some secure environments might require Data Centric Security (DCS) measures on top of implementations of OGC API - Records. DCS has been a key topic in recent OGC Testbeds [3] [4]. "The motivation for data centric security is a response to the possibility of an unauthorized user who intercepts network traffic or hacks systems storing sensitive data. When looking at drafting OGC standards such as OGC API - Features in a data centric security scenario, standards need to include ways to classify the security requirements around data access" [4]. Some organizations might have metadata records that need to be protected. The motivation for DCS therefore also applies to OGC API - Records, and other OGC API specifications.

8.5. Lessons Learnt

Towards the end of the sprint, participants held a discussion on the lessons learnt from the initiative. A summary of the lessons identified by the sprint participants is presented below:

- The relationship between OGC API – Records and STAC was clarified in this sprint. The direction of the Records API is aligning more with STAC.
- Associations between a Record metadata element offered by OGC API – Records and metadata elements from ISO 19115-3 were identified through a crosswalk to support alignment.
- There may be a bit more work to do in aligning satellite imagery support between OGC API - Records and STAC.
- Clarity, through specification, is needed on what it means to have an ISO 19115 conformance class in OGC API - Records.
- The change with OpenSearch.org introduces challenges in terms of usage license. One likely implication is that change requests will be needed for existing OGC Standards that use the OpenSearch Syndication Protocol.
- The OpenSearch Syndication Protocol is still in active use within the OGC community. It will be placed in an extension of OGC API - Records and not the Core.
- The OGC Member Meeting in September 2021 will have a Metadata Adhoc session on tackling metadata issues. The session is linked to the Singapore Geo Festival.
- The implementation of several products that support OGC API - Processes provides confidence that the candidate standard works.
- The draft user guide developed in this code sprint will help inform the development of other OGC API user guides in the future.
- OGC API - Processes is sufficiently different from WPS
- The use of JSON Schema to describe inputs and outputs will likely encourage uptake.
- There is an increasing need for Best Practices and Profiles. e.g. Routing, Maps, NDVI, ...
- The MetOcean DWG is starting to explore the possibility of an OGC API - Processes weather toolbox

Chapter 9. Conclusions

The code sprint successfully met all of its objectives and achieved its goal of progressing the development of the OGC API - Processes draft standard, OGC API - Records draft standard, and the OGC API – Coverages draft standard. There were no issues found on the Processes API, which helped to validate the maturity and stability of the API. Discussion about the Records API helped to improve understanding of the potential relationship to other related specifications (e.g. STAC and ISO 19115). Issues raised relating to the Coverages API, were focused around clarification, thereby identifying areas where the documentation could be improved. The sprint participants demonstrated that the OGC API pattern can effectively address the needs of communities that use, process and analyze geospatial data.

9.1. Future work

The following general recommendations for future work items were made during the code sprint.

9.1.1. Ideas for the OGC Innovation Program

Future work in Innovation Program could include:

- Development of Developer Guides (e.g. Spring, Python, Node.js etc), including around toolchains
- Some experimentation on Workflows (OGC API - Processes - Part 3), covering chaining
- Design and experimentation with filtering and coverage processing. Filtering at the metadata level and at the coverage cell value level
- GeoDataClass (aka StylableLayerSet) concept in relation to discovering Processes & Data that can be used together, including in the context of Workflows
- Experimentation around the workflow of a search process (e.g. ISO 19115, STAC, etc).
- Data Centric Security (DCS) support on OGC API – Records publishing metadata conforming to ISO 19115 profiles such as NMF and DMF

9.1.2. Ideas for the OGC Standards Program

Future work in the Standards Program could include:

- ETS of OGC API - Coverages
- ETS of OGC API - Records
- Merge the work done on the OpenAPI definition and JSON Schema for the Coverages API
- OGC API - Processes - Part 2: Transactions
- OGC API - Processes - Part 3: Workflows & Chaining

Appendix A: Supporting Different Metadata Encodings in OGC API - Records

A.1. Example Support of JSON encoded Metadata in OGC API - Records

The following GET request retrieves a JSON encoded metadata record from a pycsw instance deployed for the EOEPKA.

https://resource-catalogue.demo.eoepca.org/collections/metadata:main/items/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE?f=json

The response is as shown below.

```
{  
  "id": "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",  
  "type": "Feature",  
  "geometry": {  
    "type": "Polygon",  
    "coordinates": [  
      [  
        [  
          [19.88,  
           36.06  
         ],  
         [  
           [19.88,  
            37.04  
         ],  
         [  
           [21.11,  
            37.04  
         ],  
         [  
           [21.11,  
            36.06  
         ],  
         [  
           [19.88,  
            36.06  
         ]  
       ]  
     ]  
   ]  
 },  
 }},
```

```

"properties": {
    "externalId": "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
    "recordUpdated": "2021-04-19T13:34:16Z",
    "type": "dataset",
    "created": "2020-09-30T10:57:31.000000Z",
    "updated": "2020-09-30T10:57:31.000000Z",
    "title": "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
    "description": "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
    "keywords": [
        "Orthoimagery",
        "Land cover",
        "Geographical names",
        "data set series",
        "processing",
        "eo:productType:/",
        "eo:orbitNumber:/",
        "eo:orbitDirection:/",
        "eo:processingLevel:Level-1C"
    ],
    "extents": {
        "spatial": {
            "bbox": [
                [
                    19.88,
                    36.06,
                    21.11,
                    37.04
                ]
            ],
            "crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
        }
    }
},
"associations": [
{
    "href": "s3://EODATA/Sentinel-2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE/",
    "name": "product",
    "description": "product",
    "type": "enclosure"
},
{
    "href": "s3://EODATA/Sentinel-2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE/"
}
]
}

```

```
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B01.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B02.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B03.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B04.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B05.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
```

```

T092031_B06.jp2",
  "name": "granule",
  "description": "granule",
  "type": "image/jp2"
},
{
  "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B07.jp2",
  "name": "granule",
  "description": "granule",
  "type": "image/jp2"
},
{
  "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B08.jp2",
  "name": "granule",
  "description": "granule",
  "type": "image/jp2"
},
{
  "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B08A.jp2",
  "name": "granule",
  "description": "granule",
  "type": "image/jp2"
},
{
  "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B09.jp2",
  "name": "granule",
  "description": "granule",
  "type": "image/jp2"
},
{
  "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B10.jp2",
  "name": "granule",

```

```

    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B11.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_B12.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
T092031_TCI.jp2",
    "name": "granule",
    "description": "granule",
    "type": "image/jp2"
},
{
    "href": "https://data-
access.demo.eopca.org/ows?service=WMS&version=1.3.0&request=GetCapabilities&
cql=identifier%3D%22S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105
731.SAFE%22",
    "name":
"S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
    "description": "WMS URL for
S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
    "type": "OGC:WMS"
},
{
    "href": "https://data-
access.demo.eopca.org/ows?service=WCS&version=2.0.1&request=DescribeEOCovera
geSet&eoid=S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE"
,
    "name":

```

```

    "S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
      "description": "WCS URL for
    S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE",
      "type": "OGC:WCS"
    }
  ]
}

```

A.2. Example Support of ISO 19115-3 encoded Metadata in OGC API - Records

The same metadata record can be retrieved encoded in XML conforming to ISO 19115-3 through the request below:

https://resource-catalogue.demo.eoepca.org/collections/metadata:main/items/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T105731.SAFE?f=xml

The response is as shown below.

```

<gmi:MI_Metadata xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:gmd=
"http://www.isotc211.org/2005/gmd" xmlns:gmi=
"http://www.isotc211.org/2005/gmi" xmlns:gml="http://www.opengis.net/gml"
xmlns:gmx="http://www.isotc211.org/2005/gmx" xmlns:xlink=
"http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:schemaLocation="http://www.isotc211.org/2005/gmd
http://www.isotc211.org/2005/gmd/gmd.xsd http://www.isotc211.org/2005/gmx
http://www.isotc211.org/2005/gmx/gmx.xsd http://www.isotc211.org/2005/gmi
http://www.isotc211.org/2005/gmx/gmi.xsd">
  <gmd:fileIdentifier>

<gco:CharacterString>S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE</gco:CharacterString>
  </gmd:fileIdentifier>
  <gmd:language>
    <gmd:LanguageCode codeList="http://www.loc.gov/standards/iso639-2/"
codeSpace="ISO 639-2" codeListValue="eng">eng</gmd:LanguageCode>
  </gmd:language>
  <gmd:characterSet>
    <gmd:MD_CharacterSetCode codeList=
"http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Characte
rSetCode" codeSpace="ISOTC211/19115" codeListValue="utf8">
    utf8</gmd:MD_CharacterSetCode>
  </gmd:characterSet>
  <gmd:parentIdentifier>

```

```

<gco:CharacterString>S2MSI1C</gco:CharacterString>
</gmd:parentIdentifier>
<gmd:hierarchyLevel>
  <gmd:MD_ScopeCode codeList=
"http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ScopeCod
e" codeSpace="ISOTC211/19115" codeListValue="dataset">
dataset</gmd:MD_ScopeCode>
  </gmd:hierarchyLevel>
<gmd:contact>
  <gmd:CI_ResponsibleParty id="contact-pointOfContact">
    <gmd:contactInfo>
      <gmd:CI_Contact>
        <gmd:phone>
          <gmd:CI_Telephone>
            <gmd:voice gco:nilReason="missing"/>
            <gmd:facsimile gco:nilReason="missing"/>
          </gmd:CI_Telephone>
        </gmd:phone>
        <gmd:address>
          <gmd:CI_Address>
            <gmd:postalCode>
              <gco:CharacterString/>
            </gmd:postalCode>
          </gmd:CI_Address>
        </gmd:address>
        <gmd:onlineResource>
          <gmd:CI_OnlineResource>
            <gmd:linkage>
              <gmd:URL/>
            </gmd:linkage>
            <gmd:protocol>
              <gco:CharacterString>WWW:LINK</gco:CharacterString>
            </gmd:protocol>
            <gmd:function>
              <gmd:CI_OnLineFunctionCode codeList=
"http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_OnLineFu
nctionCode" codeListValue="information" codeSpace="ISOTC211/19115">
information</gmd:CI_OnLineFunctionCode>
              </gmd:function>
            </gmd:CI_OnlineResource>
          </gmd:onlineResource>
        </gmd:CI_Contact>
      </gmd:contactInfo>
      <gmd:role>
        <gmd:CI_RoleCode codeList=
"http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode
" codeSpace="ISOTC211/19115" codeListValue="pointOfContact">

```

```

pointOfContact</gmd:CI_RoleCode>
    </gmd:role>
    </gmd:CI_ResponsibleParty>
</gmd:contact>
<gmd:dateStamp>
    <gco:DateTime>2020-09-30T10:57:31.00000Z</gco:DateTime>
</gmd:dateStamp>
<gmd:metadataStandardName>
    <gco:CharacterString>ISO 19115:2003 - Geographic information -
Metadata</gco:CharacterString>
    </gmd:metadataStandardName>
<gmd:metadataStandardVersion>
    <gco:CharacterString>ISO 19115:2003</gco:CharacterString>
</gmd:metadataStandardVersion>
<gmd:dataSetURI>
    <gco:CharacterString/>
</gmd:dataSetURI>
<gmd:spatialRepresentationInfo>
</gmd:spatialRepresentationInfo>
<gmd:referenceSystemInfo>
    <gmd:MD_ReferenceSystem>
        <gmd:referenceSystemIdentifier>
            <gmd:RS_Identifier>
                <gmd:authority>
                    <gmd:CI_Citation>
                        <gmd:title>
                            <gco:CharacterString>European Petroleum Survey Group (EPSG)
Geodetic Parameter Registry</gco:CharacterString>
                        </gmd:title>
                        <gmd:date>
                            <gmd:CI_Date>
                                <gmd:date>
                                    <gco:Date>2008-11-12</gco:Date>
                                </gmd:date>
                                <gmd:dateType>
                                    <gmd:CI_DateTypeCode codeList=
"mailto://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateType
Code" codeSpace="ISOTC211/19115" codeListValue="publication">
publication</gmd:CI_DateTypeCode>
                                    </gmd:dateType>
                                    <gmd:CI_Date>
                                </gmd:date>
                                <gmd:citedResponsibleParty>
                                    <gmd:CI_ResponsibleParty>
                                        <gmd:organisationName>
                                            <gco:CharacterString>European Petroleum Survey
Group</gco:CharacterString>

```

```

        </gmd:organisationName>
        <gmd:contactInfo>
            <gmd:CI_Contact>
                <gmd:onlineResource>
                    <gmd:CI_OnlineResource>
                        <gmd:linkage>
                            <gmd:URL>http://www.epsg-registry.org</gmd:URL>
                        </gmd:linkage>
                    </gmd:CI_OnlineResource>
                </gmd:onlineResource>
            </gmd:CI_Contact>
        </gmd:contactInfo>
        <gmd:role>
            <gmd:CI_RoleCode codeList=
"urn:ogc:def:crs:EPSG:4326"
"codeSpace="ISOTC211/19115" codeListValue="originator">
            originator</gmd:CI_RoleCode>
            </gmd:role>
            </gmd:CI_ResponsponsibleParty>
            </gmd:citedResponsibleParty>
            </gmd:CI_Citation>
        </gmd:authority>
        <gmd:code>
            <gco:CharacterString>
urn:ogc:def:crs:EPSG:4326</gco:CharacterString>
            </gmd:code>
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                <gco:CharacterString>6.18.3</gco:CharacterString>
            </gmd:version>
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            </gmd:referenceSystemIdentifier>
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5731.SAFE</gco:CharacterString>
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                            </gmd:date>
                        </gmd:CI_Date>
                    </gmd:date>
                </gmd:CI_Citation>
            </gmd:citation>
        </gmd:MD_DataIdentification>
    </gmd:identificationInfo>

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creation</gmd:CI_DateTypeCode>
    </gmd:dateType>
    </gmd:CI_Date>
</gmd:date>
<gmd:date>
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        </gmd:date>
    <gmd:dateType>
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publication</gmd:CI_DateTypeCode>
        </gmd:dateType>
        </gmd:CI_Date>
    </gmd:date>
    </gmd:CI_Citation>
</gmd:citation>
<gmd:abstract>

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Code" codeSpace="ISOTC211/19115" codeListValue="onGoing">
onGoing</gmd:MD_ProgressCode>
    </gmd:status>
<gmd:resourceMaintenance>
    <gmd:MD_MaintenanceInformation>
        <gmd:maintenanceAndUpdateFrequency>
            <gmd:MD_MaintenanceFrequencyCode codeList=
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nceFrequencyCode" codeSpace="ISOTC211/19115" codeListValue="continual">
continual</gmd:MD_MaintenanceFrequencyCode>
            </gmd:maintenanceAndUpdateFrequency>
        </gmd:MD_MaintenanceInformation>
    </gmd:resourceMaintenance>
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```

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</gmd:keyword>
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</gmd:keyword>
<gmd:keyword>
    <gco:CharacterString>Geographical names</gco:CharacterString>
</gmd:keyword>
<gmd:type>
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ypeCode" codeSpace="ISOTC211/19115" codeListValue="theme">
theme</gmd:MD_KeywordTypeCode>
    </gmd:type>
    </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
<gmd:descriptiveKeywords>
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        </gmd:keyword>
        <gmd:type>
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ypeCode" codeSpace="ISOTC211/19115" codeListValue="theme">
theme</gmd:MD_KeywordTypeCode>
            </gmd:type>
            </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
<gmd:descriptiveKeywords>
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        </gmd:keyword>
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            </gmd:type>
            </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
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        </gmd:keyword>

```

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theme</gmd:MD_KeywordTypeCode>
    </gmd:type>
    </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
<gmd:resourceConstraints>
    <gmd:MD_LegalConstraints>
        <gmd:accessConstraints>
            <gmd:MD_RestrictionCode codeList=
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ionCode" codeSpace="ISOTC211/19115" codeListValue="otherRestrictions">
otherRestrictions</gmd:MD_RestrictionCode>
            </gmd:accessConstraints>
            </gmd:MD_LegalConstraints>
        </gmd:resourceConstraints>
        <gmd:spatialRepresentationType>
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epresentationTypeCode" codeSpace="ISOTC211/19115" codeListValue="grid">
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rSetCode" codeSpace="ISOTC211/19115" codeListValue="utf8">
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        <gmd:eastBoundLongitude>
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        </gmd:eastBoundLongitude>
        <gmd:southBoundLatitude>
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        </gmd:southBoundLatitude>
        <gmd:northBoundLatitude>
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        </gmd:northBoundLatitude>
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</gmd:geographicElement>
<gmd:temporalElement>
    <gmd:EX_TemporalExtent>
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30T09:20:31.024Z</gml:beginPosition>
                    <gml:endPosition>2020-09-30T09:20:31.024Z</gml:endPosition>
                </gml:TimePeriod>
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        </gmd:attributeDescription>
        <gmd:contentType>
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e" codeSpace="ISOTC211/19115" codeListValue="image">
image</gmd:MD_CoverageContentTypeCode>
        </gmd:contentType>
        <gmd:dimension>
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                <gmd:minValue>

```

```

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<gmd:dimension>
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        </gmd:minValue>
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            <gml:UnitDefinition gml:id="units-2">
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            </gml:UnitDefinition>
        </gmd:units>
        </gmd:MD_Band>
    </gmd:dimension>
<gmd:dimension>
    <gmd:MD_Band id="B3">
        <gmd:maxValue>
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        </gmd:maxValue>
        <gmd:minValue>
            <gco:Real>412</gco:Real>
        </gmd:minValue>
        <gmd:units>
            <gml:UnitDefinition gml:id="units-3">
                <gml:identifier codeSpace="none">nm</gml:identifier>
            </gml:UnitDefinition>
        </gmd:units>
        </gmd:MD_Band>
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<gmd:dimension>
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```

```

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  </gmd:MD_Band>
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<gmd:dimension>
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    <gmd:minValue>
      <gco:Real>412</gco:Real>
    </gmd:minValue>
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  </gmd:MD_Band>
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    <gmd:minValue>
      <gco:Real>412</gco:Real>
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```

```

        <gml:identifier codeSpace="none">nm</gml:identifier>
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</gmd:units>
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        </gmd:minValue>
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            </gml:UnitDefinition>
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        <gmd:minValue>
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        </gmd:minValue>
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        <gmd:minValue>
            <gco:Real>412</gco:Real>
        </gmd:minValue>
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```

```

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        <gmd:minValue>
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        </gmd:minValue>
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            </gml:UnitDefinition>
        </gmd:units>
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</gmd:dimension>
<gmd:dimension>
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        </gmd:maxValue>
        <gmd:minValue>
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        </gmd:minValue>
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            </gml:UnitDefinition>
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    <gmd:code>
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    </gmd:code>
  </gmd:RS_Identifier>
</gmd:processingLevelCode>
</gmd:MD_ImageDescription>
</gmd:contentInfo>
<gmd:distributionInfo>
  <gmd:MD_Distribution>
    <gmd:distributor>
      <gmd:MD_Distributor>
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          <gmd:CI_ResponsibleParty id="contact-distributor">
            <gmd:contactInfo>
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```

```

        </gmd:function>
        </gmd:CI_OnlineResource>
        </gmd:onlineResource>
        </gmd:CI_Contact>
        </gmd:contactInfo>
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" codeSpace="ISOTC211/19115" codeListValue="distributor">
distributor</gmd:CI_RoleCode>
            </gmd:role>
            <gmd:CI_ResponsibleParty>
                </gmd:distributorContact>
            </gmd:MD_Distributor>
        </gmd:distributor>
        <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
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                            <gmd:URL>s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/</gmd:URL>
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                    </gmd:description>
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download</gmd:CI_OnLineFunctionCode>
                        </gmd:function>
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                        <gmd:linkage>
                            <gmd:URL>s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930

```

```

T092031_B01.jp2</gmd:URL>
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    </gmd:name>
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    </gmd:description>
    <gmd:function>
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download</gmd:CI_OnLineFunctionCode>
        </gmd:function>
        </gmd:CI_OnlineResource>
    </gmd:onLine>
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        <gmd:CI_OnlineResource>
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2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
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download</gmd:CI_OnLineFunctionCode>
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```

```

<gmd:URL>s3://EODATA/Sentinel-
2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
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        </gmd:function>
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    </gmd:onLine>
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2/MSI/L1C/2020/09/30/S2A_MSIL1C_20200930T092031_N0209_R093_T34SDF_20200930T10
5731.SAFE/GRANULE/L1C_T34SDF_A027546_20200930T092345/IMG_DATA/T34SDF_20200930
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```

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Appendix B: Mappings from OGC API - Records Queryables to ISO 19115-3

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
recordId	M	A unique record identifier assigned by the server.	//mdb:MD_Metadata /mcc:MD_Id entifier	M	Unique identifier for the metadata record	
recordCreated	O	The date this record was created in the server.	//mdb:MD_Metadata /mdb:dateIn fo /cit:CI_Date /cit:date --With-- /cit:dateType /cit:CI_Date TypeCode @codeListValue="creation"	M	date(s) associated with the metadata NOTE Creation date must be provided, others can also be provided	
recordUpdated	O	The most recent date on which the record was changed.	//mdb:MD_Metadata /mdb:dateIn fo /cit:CI_Date /cit:date --With-- /cit:dateType /cit:CI_Date TypeCode @codeListValue="lastUpdate"	O	date(s) associated with the metadata NOTE Creation date must be provided, others can also be provided	

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
links	O	A list of links for navigating the API.	For link to self For link to alternate source - For link to parent -	type	M	The nature or genre of the resource.
//mdb:MD_Metadata /mdb:metadataScope /mdb:MD_MetadataScope /mdb:resourceScope	M	the scope/type of resource for which metadata is provided. From codelist - MD_ScopeCode		title	M	A human-readable name given to the resource.
//mdb:MD_Metadata /mdb:identificationInfo /mri:citation /cit:CI_Citation /cit:title	M	name by which the cited resource is known		description	O	A free-text description of the resource.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datadescription /mri:citation /cit:CI_Citation /cit:abstract	M	brief narrative summary of the resource		keywords	O	A list of keywords or tag associated with the resource.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datalidentification on /mri:descriptiveKeywords /mri:MD_Ke ywords /mri:keywor d	O	commonly used word(s) or formalised word(s) or phrase(s) used to describe the subject		keywordsCo despace	O	A reference to a controlled vocabulary used for the keywords property.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datalidentification on /mri:descriptiveKeywords /mri:MD_Ke ywords /mri:thesaur usName	O	name of the formally registered thesaurus or a similar authoritative source of keywords		language	O	This refers to the natural language used for textual values.
For the record- /mdb:defaultLocale For the resource- /mdb:identificationInfo /mri:MD_Datalidentification on /mdb:defaultLocale	O	language and character set used for documenting metadata Or language and character set used within the resource	Is this for the record or the resource?	externalId	O	An identifier for the resource assigned by an external entity.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datalocation /mri:citation /cit:CI_Citation /cit:identifier	O	value uniquely identifying an object within a namespace	Part of the CI_Citation class. Used in multiple locations	updated	O	The more recent date on which the resource was changed.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datalocation /mri:citation /cit:CI_Citation /cit:date --With-- /cit:dateType /cit:CI_Date TypeCode @codeListValue="lastUpdate"	O	reference date for the cited resource		publisher	O	The entity making the resource available.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datadentification on /mri:pointOfContact --With-- /cit:role /CI_RoleCode @codeListValue=“publis her” —And/Or— /mdb:distrib utionInfo /mrd:MD_Dis tribution /mrd:distrib utor /mrd:MD_Dis tributor /mrd:distrib utorContact	O		At least 3 possible locations. Could also be captured under dataset citation citedResponsibleParty	themes	O	A knowledge orgnaization system used to classify the resource.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datadentification on /mri:topicCategory	O	main theme(s) of the resource from enumeration “MD_TopicCategoryCode”		formats	O	A list of available distributions for the resource.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:distributionInfo /mrd:MD_Distribution /mrd:MD_Format	O	description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel		contactPoint	O	An entity to contact about the resource.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_DataIdentification /mri:pointOfContact --With-- /cit:role /CI_RoleCode @codeListValue="pointOfContact"	O	identification of, and means of communication with, person(s) and organisation(s) associated with the resource		license	O	A legal document under which the resource is made available.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datalocation /mri:resourceConstraints /mco:MD_LegalConstraints With either /mco:accessConstraints or /mco:useConstraints /mco:MD_RestrictionCode @codeListValue="license"	O	restrictions and legal prerequisites for accessing and using the resource or metadata	both license and copyright are captured as legal constraints	rights	O	A statement that concerns all rights not addressed by the license such as a copyright statement.

Queryables	Obligation	Description	ISO 19115-1 (for dataset metadata)	ISO Obligation	ISO Definition	Notes
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datadescription /mri:resourceConstraints /mco:MD_LegalConstraints With either /mco:accessConstraints or /mco:useConstraints /mco:MD_RestrictionCode @codeListValue="copyright"	O		both license and copyright are captured as legal constraints	extent	O	The spatio-temporal coverage of the resource.
//mdb:MD_Metadata /mdb:identificationInfo /mri:MD_Datadescription /mri:extent /gex:EX_Extent	O	spatial and temporal extent of the resource		associations	O	A list of links for accessing the resource, links to other resources associated with this resource, etc.

Appendix C: Revision History

Date	Editor	Release	Primary clauses modified	Descriptions
2020-11-12	G. Hobona	.1	all	initial version

Table 1. Revision History

Appendix D: Bibliography

- [1] OpenSearch Syndication Protocol Community: OpenSearch Syndication Protocol, <https://github.com/dewitt/opensearch>.
- [2] STAC Community: The SpatioTemporal Asset Catalog (STAC) specification. Radiant Earth Foundation, <https://stacspec.org> (2019).
- [3] Balaban, A.: OGC Testbed-16: Data Centric Security Engineering Report. OGC 20-021r2, Open Geospatial Consortium, <https://docs.ogc.org/per/20-021r2.html> (2021).
- [4] Leedahl, M.A.: OGC Testbed-15: Data Centric Security. OGC 19-016r1, Open Geospatial Consortium, <http://docs.opengeospatial.org/per/19-016r1.html> (2019).