OAPI-Coverages

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October, 2021

The world's leading and comprehensive community of experts making location information:

- Findable
- Accessible
- Interoperable
- Reusable

OGC®

Wait…"Coverages" ?

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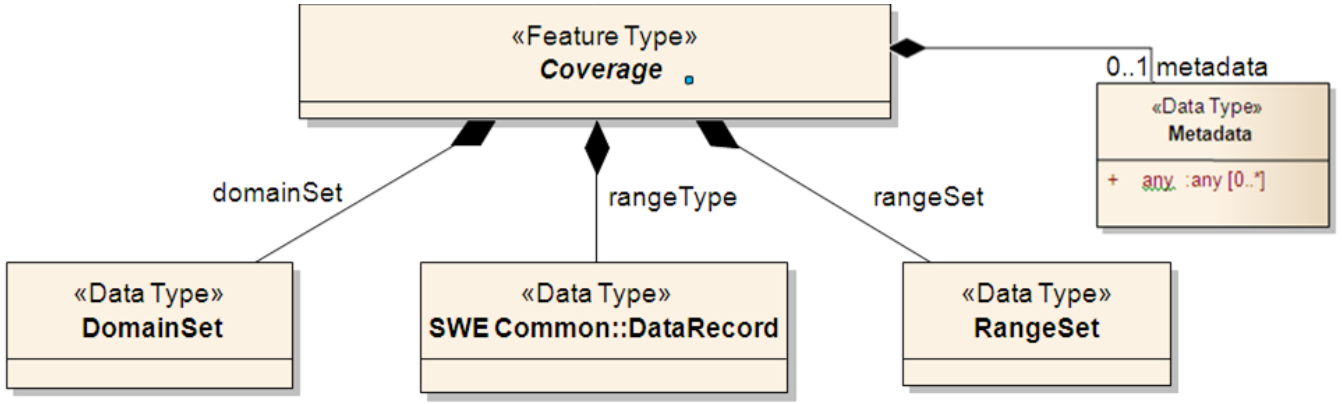
Current scope of OAPI

- Coverage = n-D „field“
  - regular & irregular grids, point clouds, meshes
- OGC Coverage Implementation Schema (CIS) 1.1
  - Identical to ISO 19123-2, EU INSPIRE coverages
  - Incompatible: CoverageJSON
- Basic structure of a coverage:



Coverages – in GML, JSON, RDF, …

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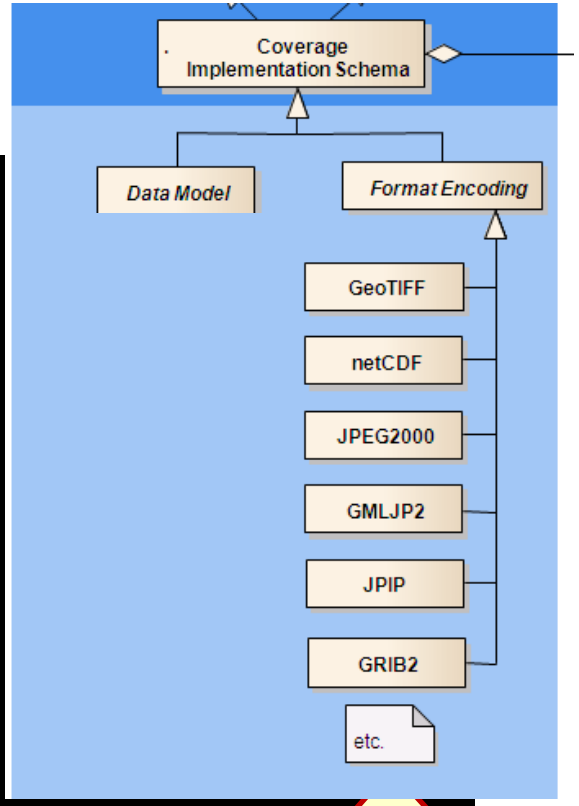
```
<generalGridCoverage ...  gml:id="CIS_001">

    <domainSet>
        <generalGrid srsName="http://www.opengis.net/def/crs-compound?
                                    1=http://www.opengis.net/def/crs/EPSG/0/4979
                                    &amp;2=http://www.opengis.net/def/crs/OGC/0/AnsiDate"

            axisLabels
            <regularAx
            <regularAx
            <irregular
                <c>  0
                <c>100
            </irregula
            <irregular
                <c>201
                <c>201
            </irregula
            <gridLimit
                <index
                <index
                <index
                <index
            </gridLimi
        </generalGrid>
    </domainSet>

    <rangeSet>
        <dataBlock>
                <v>01</
                <v>01</
                <v>01</
                <v>01</
        </dataBlock>
    </rangeSet>

    <rangeType>
        <swe:DataRecor
            <swe:field
                <swe:Q
                    <s
                </swe:
            </swe:fiel
        </swe:DataReco
    </rangeType>

</generalGridCoverage>
```

```
{  "type": "CoverageByDomainAndRangeType",
   "domainSet":{
      "type": "DomainSetType",
      "generalGrid":{
         "type":        "GeneralGridCover
         "srsName":    "http://www.opengi
         "axisLabels": ["i", "j"],
         "axis": [{      "type": "IndexAxisTy
         },{             "type": "IndexAxisTy
      }
   },
   "rangeSet": {     "type": "RangeSetTyp
                     "dataBlock": { "type": '
   "rangeType": {    "type": "DataRecordT
                     "field":[{     "type": "Qu
                                    "definition'
                                    "uom": { "t'
   }
}
```

```
<http://www.opengis.net/cis/1.1/examples/CIS_05_2D>
 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
 <http://www.opengis.net/cis/1.1/CoverageByDomainAndRangeType> .

<http://www.opengis.net/cis/1.1/examples/CIS_05_2D>
 <http://www.opengis.net/cis/1.1/domainSet>
 <http://www.opengis.net/cis/1.1/examples/CIS_DS_05_2D> .
<http://www.opengis.net/cis/1.1/examples/CIS_DS_05_2D>
 <http://www.opengis.net/cis/1.1/generalGrid>
 <http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_05_2D> .
<http://www.opengis.net/cis/1.1/examples/CIS_DS_05_2D>
 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
 <http://www.opengis.net/cis/1.1/DomainSetType> .
<http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_05_2D>
 <http://www.opengis.net/cis/1.1/axis>
 <http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_I_05_2D> .
<http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_05_2D>
 <http://www.opengis.net/cis/1.1/axis>
 <http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_J_05_2D> .
<http://www.opengis.net/cis/1.1/examples/CIS_DS_GG_05_2D>
 <http://www.opengis.net/cis/1.1/axisLabels>
 <http://www.opengis.net/cis/1.1/axisLabels0> .
<http://www.opengis.net/cis/1.1/axisLabels0> <http://www.w3.org/1999/02/22-rdf-syntax-ns#first> "i" .
```



Interoperability: can translate all

Coverage Service Model, Classic

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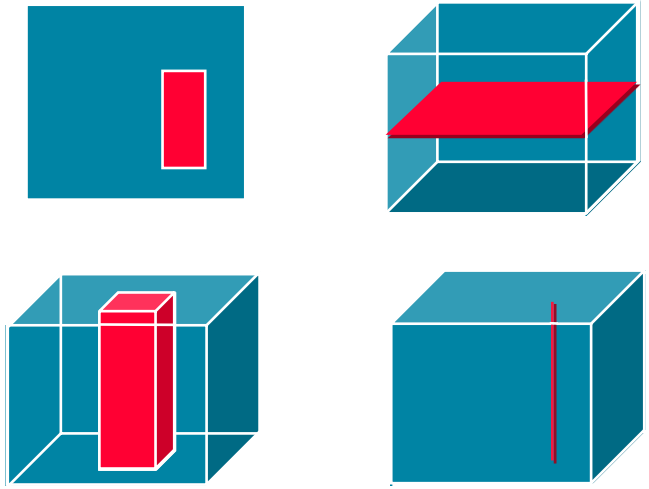
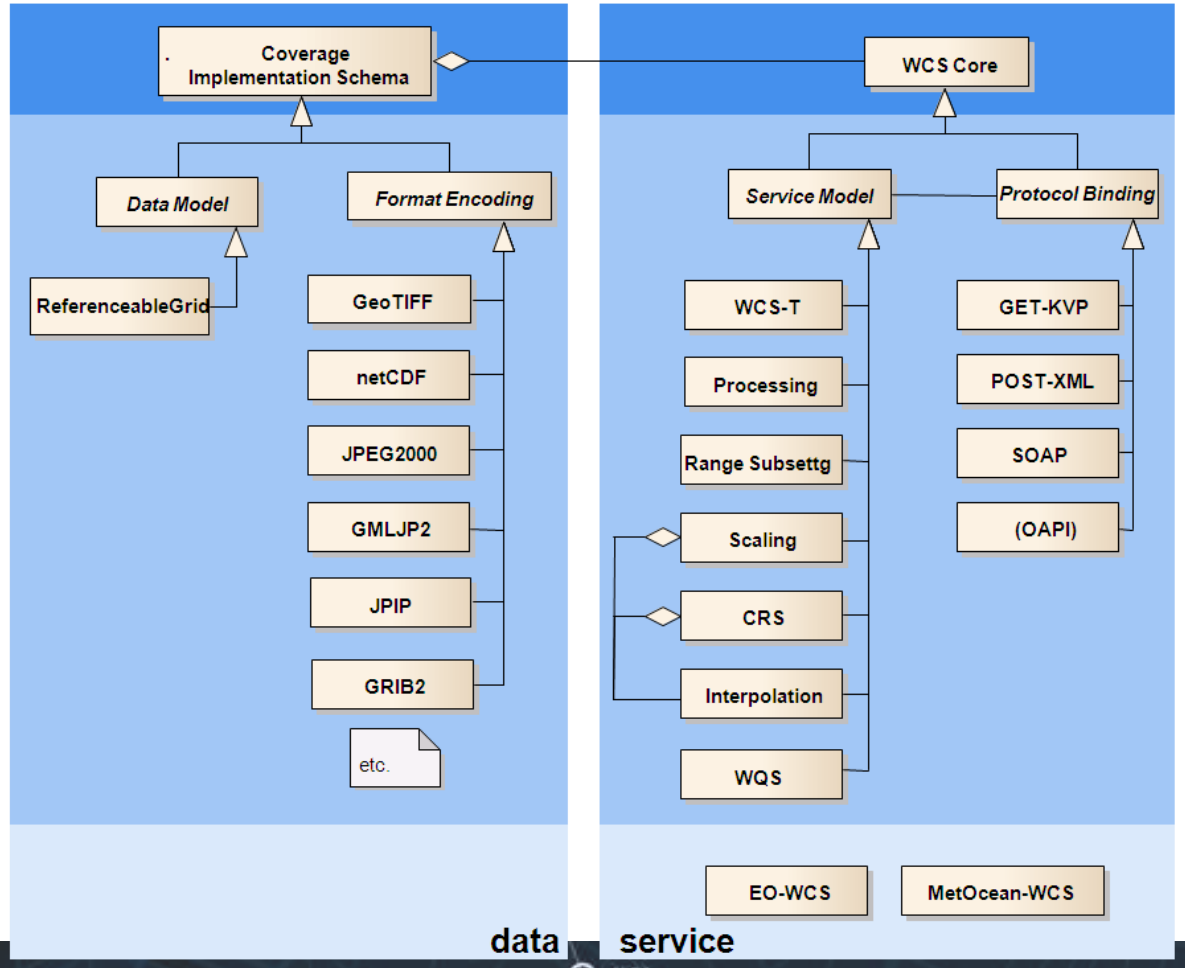
- Many services can support coverages
  - Web Coverage Service, WMS, WPS, SOS, ...

Most specific functionality

- Modular WCS suite
  - from simple subsetting to complex analytics





OAPI-Coverages

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- Member of the OAPI-* family:
  - being accessible from an API landing page for a particular dataset,
  - enabling the API to be described and documented using OpenAPI,
  - defining conformance classes specific to coverages,
  - providing access to geospatial data as a coverage.
- Primary focus on (YAML +) HTML + JSON
- Status: draft, under active development
  - Spec: https://github.com/opengeospatial/ogcapi-coverages
- Several implementations
  - Gnosis, INRS, EOX, Spatialys, rasdaman, 52° North, Pangaea Innovation, CREAF, CubeWerx, CRIM, ...

OAPI-Coverages: Access Structure

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- List collections — {datasetAPI}/collections
- Description of {coverageId} — {datasetAPI}/collections/{coverageId}
  - All but range set, coverage metadata
- The coverage itself — {datasetAPI}/collections/{coverageId}/coverage
- Optional query parameters:
  - Subset — {datasetAPI}/collections/{coverageId}/coverage?subset=Lat(40:50),Lon(10:20)
  - Range subset — {datasetAPI}/collections/{coverageId}/coverage?range-subset=B02,B03,B04
  - Scaling — {datasetAPI}/collections/{coverageId}/coverage?scale-factor=2
  - Bbox — {datasetAPI}/collections/{coverageId}/coverage?bbox=10,40,20,50
- Coverage parts:
  - {datasetAPI}/collections/{collectionId}/coverage/domainset
  - {datasetAPI}/collections/{collectionId}/coverage/rangetype
  - {datasetAPI}/collections/{collectionId}/coverage/rangeset

YAML API Specification

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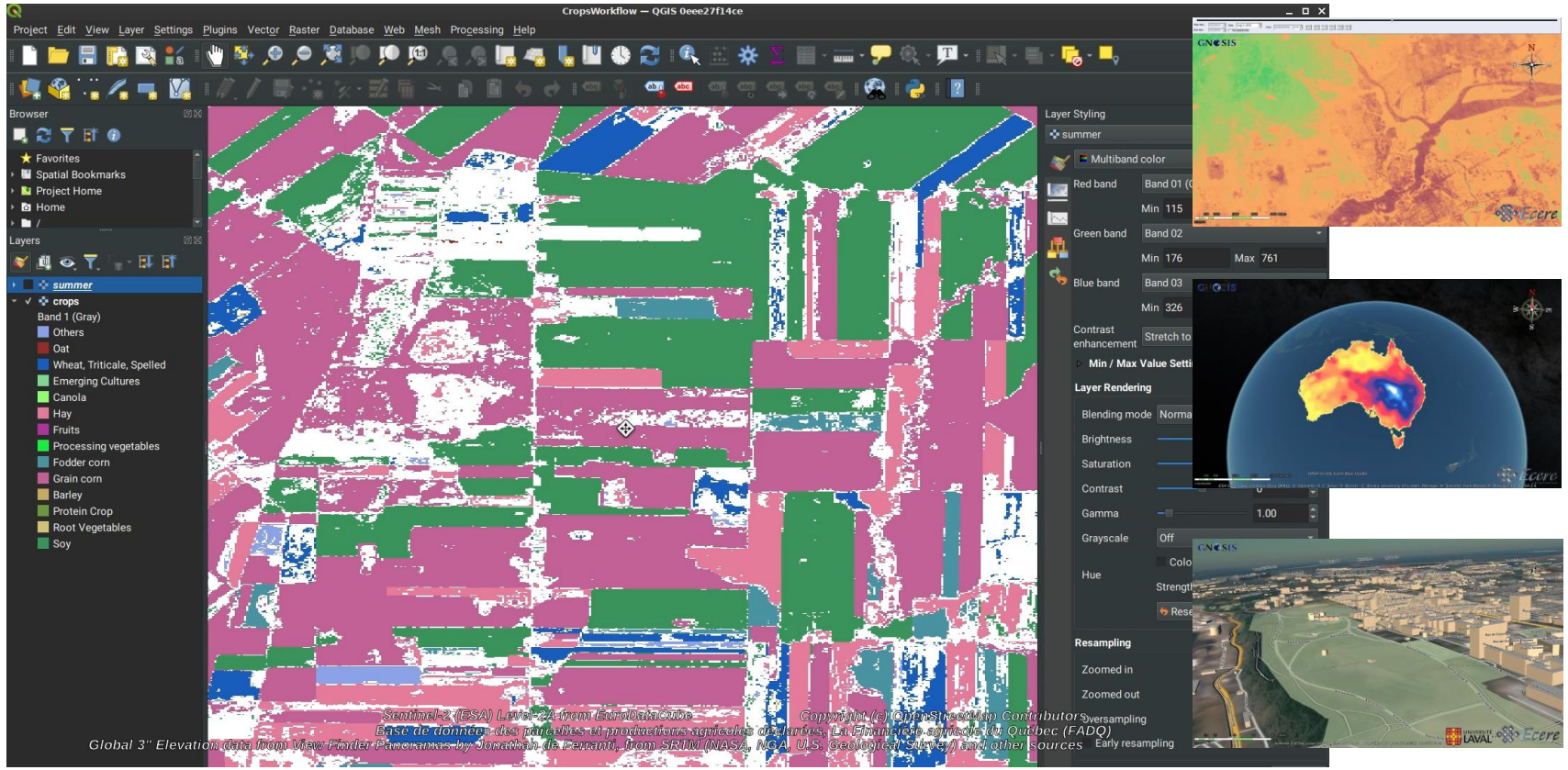
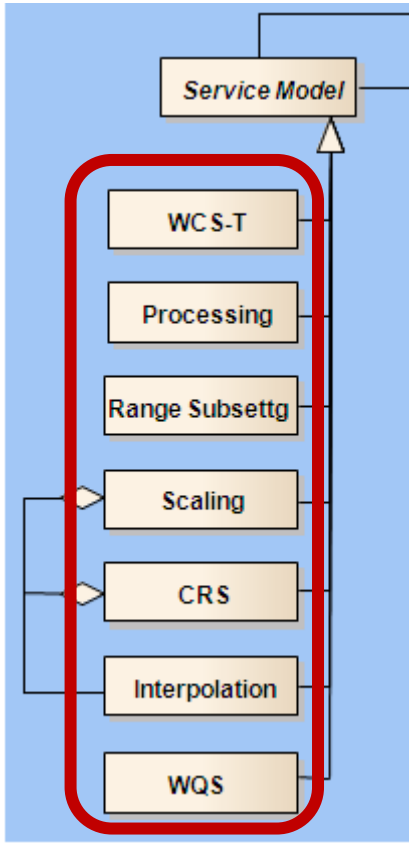
- 2-level specification
  - Invocation syntax → YAML
  - Op semantics → text
- Ex: subsetting
- YAML aka Remote Procedure Call
  - RPC/XDR - C
  - WSDL - XML

```
name: subset
in: query
description: |-
  The `subset` parameter allows for subsettings against a given coverage axis
  with the following characteristics (using an Extended Backus Naur Form (EBNF)
  fragment):
  ```
  SubsetSpec: "subset"=axisName(intervalOrPoint)[,axisName(intervalOrPoint)]*
  axisName: {text}
  intervalOrPoint: interval | point
  interval: low : high
  low: point | *
  high: point | *
  point: {number} | "{text}"
  Where:
    \" = double quote = ASCII code 0x42,
    {number} is an integer or floating-point number, and
    {text} is some general ASCII text (such as a time and date notation in ISO 8601).
  ```
required: false
schema:
  type: string
```

- Modular OGC API Workflows
  - Ecere, Université Laval, INRS, EOX, Spatialys, rasdaman, 52° North, Pangaea Innovation, CREAF, CubeWerx, CRIM
- 2020-2021
- funding: NRCan
- Impact:
  - OAPI-Coverages
  - OAPI-Processes



WCS vs OAPI-Coverages: High-Level Comparison



	WCS:	OAPI-Coverages:
Space/time bbox subsetting	✓	✓
Format encoding	✓	✓
Range subsetting	✓	✓
Reprojection	✓	✓
Scaling	✓	✓
Interpolation	✓	✗
Datacube analytics (WCPS)	✓	✓
Transaction = insert/update/delete	✓	✗

WCS vs OAPI-Coverages: Subsetting

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- Subsetting as example for functionality comparison

- WCS: ?subset=Long(100,120)&subset=Lat(50,60)&subset=time("2009-11-06T23:20:52")

- OAPI: ?bbox=160.6,-55.95,-170,-25.89
  ?subset=Lat(40:50),Lon(10:20),time("2009-11-06T23:20:52")

- Generic n-D subsetting as conformance class in OAPI-Common

(Client) Developer Hints

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- Follow links, carefully understand link relation types!
  - "this path is not fixed and may not exist (follow the link)"
  - Ex: {datasetAPI}/collections/{collectionId}/coverage/domainset vs external reference via link
- Expect the unexpected → „resource sniffing"
  - WCS Capabilities: list only coverages
  - OAPI {datasetAPI}/collections : list data available, "some of which may support being accessed as a coverage"
- If in doubt, check user guide (to come)
  - https://github.com/opengeospatial/ogcapi-coverages/tree/master/users-guide
- If JSON, use OGC Coverage Implementation Schema: CIS JSON
  - CoverageJSON, W3C Coverages incompatible

WCPS Datacube Analytics

basis of ISO 19123-3

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- OGC Web Coverage Processing Service = geo datacube analytics language
  - Semantic interoperability
  - automatic server-side optimization + parallelization + distribution

```
for $c in ( M1, M2, M3 )
where some( $c.nir > 127 )
return max( $c.red - $c.nir )
```

- Protocol independent:
  - WCS: http://acme.com/wcs?SERVICE=WCS&VERSION=2.0.1&REQUEST=ProcessCoverages&QUERY=for $c in (ERA5-cube) return max($c.temperature)
  - OAPI: http://acme.com/oapi/wcps?q=for $c in (ERA5-cube) return max($c.temperature)

- Proven on multi-PB EarthServer.xyz datacube federation

Summary

- OAPI-Coverages: OpenAPI support for coverage services
  - Based on Coverage Implementation Schema (CIS) standard
  - YAML-centric
- Evolution, not revolution of coverage services
  - Code can reuse WCS functionality → preserve investment
  - Subtle changes → caveat developer
- To be done:
  - Start test suite
  - 35 open issues + 7 todos
  - User guide
  - Start adoption process
- Enhancement to OGC's service ecosystem