EOEPCA Resource Management

Resource Management Operators support

EOX IT Services https://eox.at

EOfarm P.C. http://eofarm.com

EOEPCA Operators demo 2022-09-20

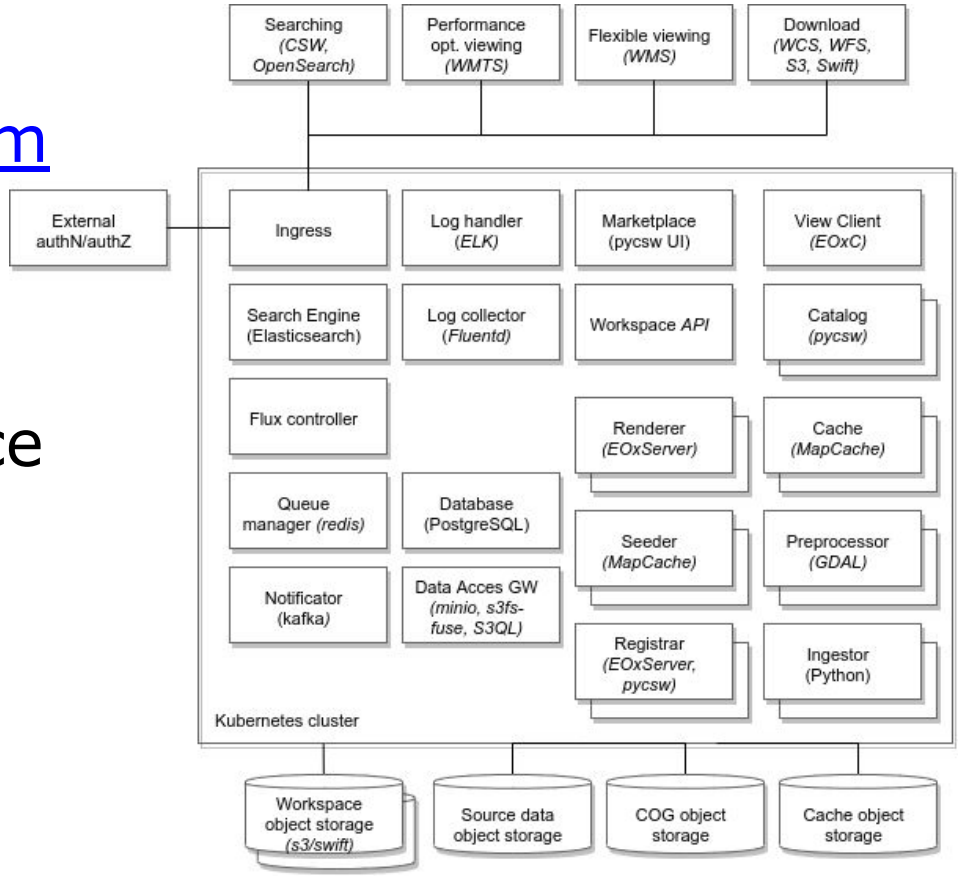
Overview

- Team
- Resource Management Architecture
- Resource Catalogue
- Data Access Service & Ingestion
- User Workspace
- Summary

Team

Resource Management Architecture

- Heavily based on [Python geospatial stack/ecosystem]
- Kubernetes mainly using helm charts
- Automation via flux
- System and per Workspace deployments



Resource Catalog Overview

- Discover/Search, Harvest, Distributed/Federated Search (user and system catalog)
- Metadata
- Standards
  - ISO 19115/19139
  - OGC CSW 2.0.2 / 3.0.0
    - Core Profile
    - ISO Application Profile
    - OGC OpenSearch Geo/Time, EO Profiles
  - OGC API - Records - Part 1: Core
  - STAC API (1.0.0-rc1), STAC Item (1.0.0)

Resource Catalog Technologies

- pycsw
  - Python OGC Reference Implementation Server
  - Multiple metadata formats (ISO, DC etc.)
  - Flexible backends (RDBMS)
- OWSLib
  - Swiss army knife Python client library for OGC Web Services and APIs
- pygeometa
  - Metadata composition
- pygeoapi
  - Python OGC Server Reference Implementation
  - evolving OGC API standards

Resource Catalogue Technologies

- PostGIS
  - PostgreSQL Spatial extension
  - OGC SFSQL
  - Metadata Store for pycsw, EOxServer
- Elasticsearch (in Roadmap)
  - Full Text Search Engine
  - Highly Distributed

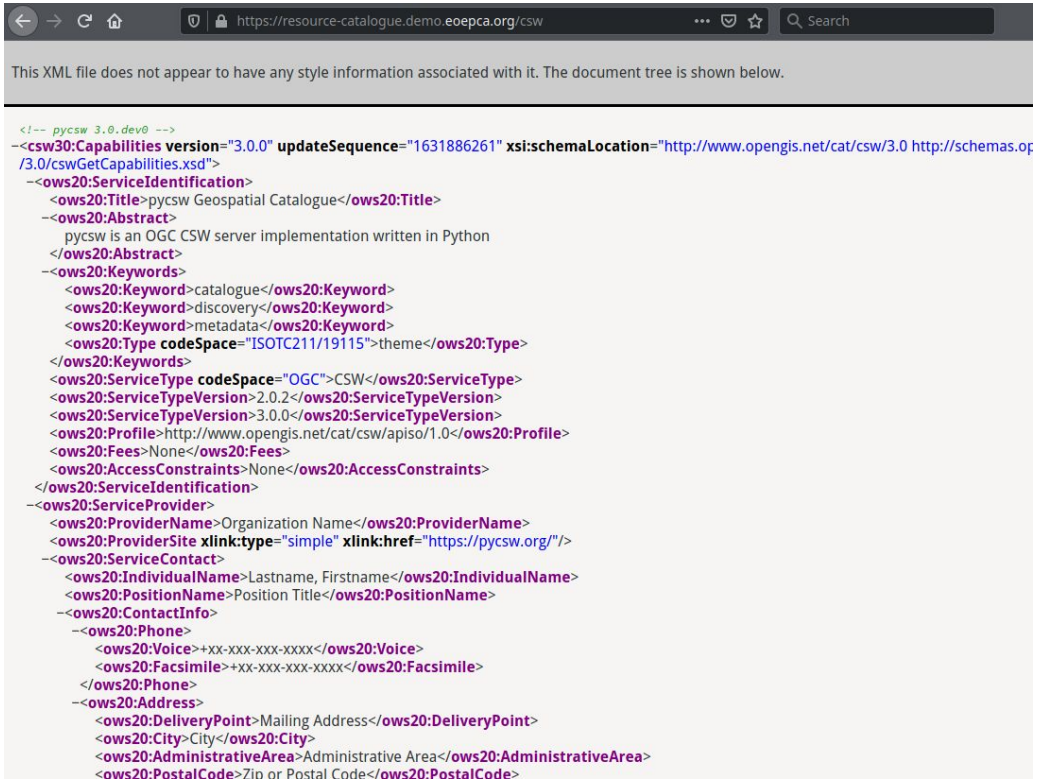
Resource Catalogue Configuration

- Helm Chart available: https://github.com/EOEPCA/helm-charts/releases/tag/rm-resource-catalogue-1.1.0
- pycsw
  - Configuration via helm chart values: https://github.com/EOEPCA/helm-charts/blob/main/charts/rm-resource-catalogue/values.yaml#L53-L131
  - Can be scaled vertically and horizontally since it is a stateless service, just add instances.
  - Populate the catalogue through:
    - pycsw-admin CLI: https://docs.pycsw.org/en/latest/administration.html#loading-records
    - OGC CSW-T:

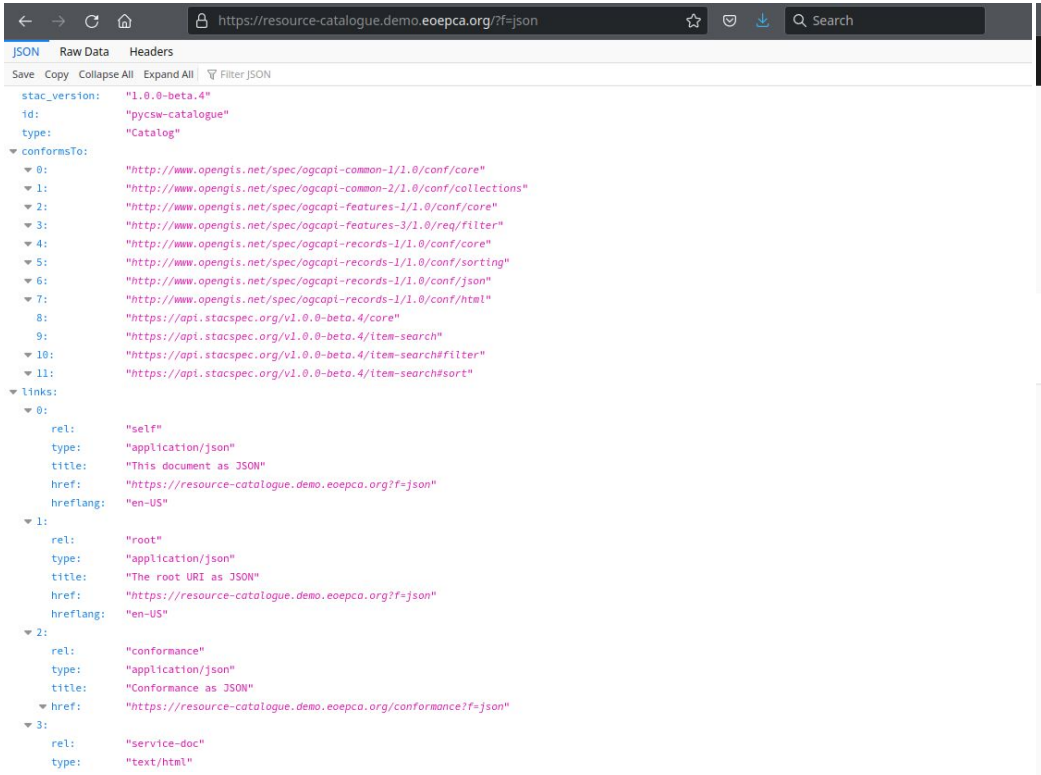
Resource Catalogue Configuration

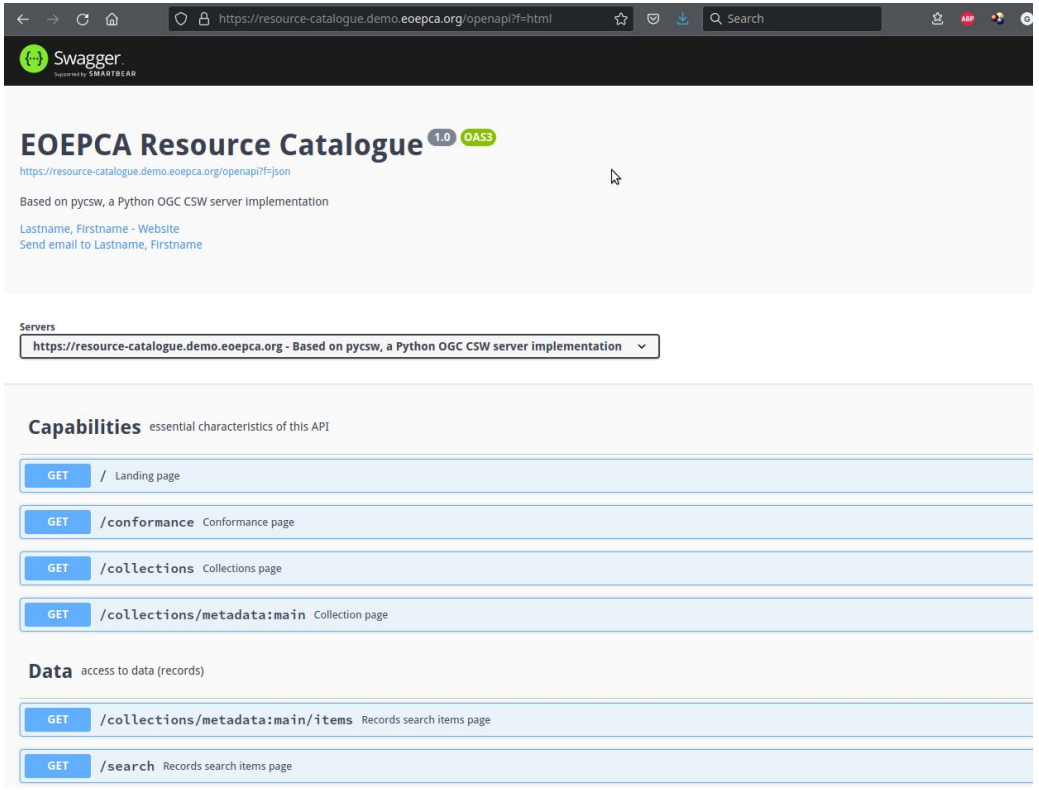
- PostgreSQL
  - Configuration via helm chart values: https://github.com/EOEPCA/helm-charts/blob/main/charts/rm-resource-catalogue/values.yaml#L5-L45
  - Can be highly optimized for millions of metadata records using spatial index and full text search support.
  - Can be scaled vertically
  - Horizontal scaling can be achieved in various scenarios: (i) Read Scalability through pgpool or pgbouncer by using PostgreSQL replication (ii) Read-Write Scalability using FDW and Partitioning or tools like Postgres-XL and Citus.
  - Replacing the default helm chart with a high-availability one, like Bitnami:

Resource Catalogue Examples

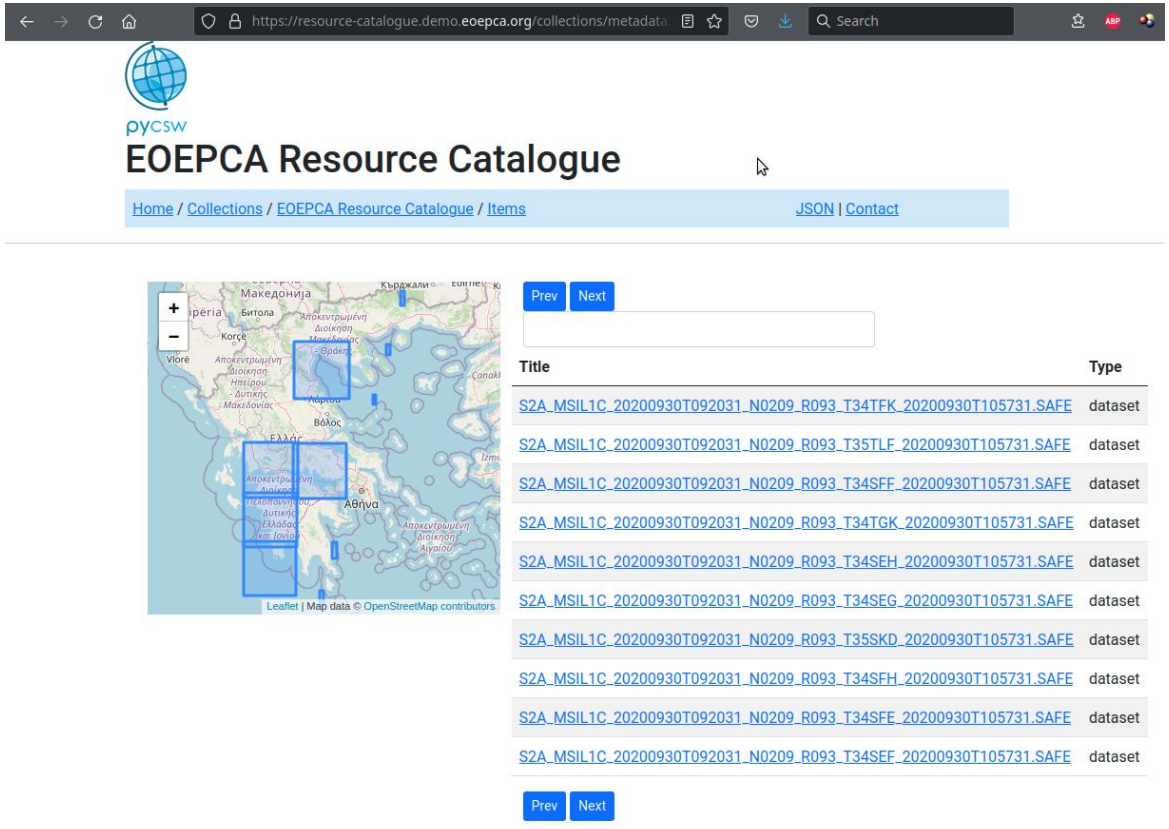


Resource Catalogue Examples





Resource Catalogue Examples



Resource Catalogue Example

https://resource-catalogue.demo.eoepca.org/collections/metadata Search

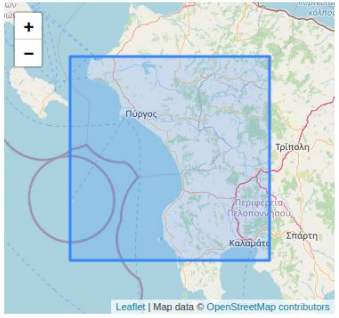
pycsw

EOEPCA Resource Catalogue

Home / Collections / EOEPCA Resource Catalogue / Items / S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE

JSON | Contact

S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE



Property	Value
datetime	2020-09-30T10:57:31.000000Z
start_datetime	2020-09-30T09:20:31.024Z
end_datetime	2020-09-30T09:20:31.024Z
externalId	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
recordUpdated	2021-12-06T16:21:09Z
type	dataset
created	2020-09-30T10:57:31.000000Z
updated	2020-09-30T10:57:31.000000Z
title	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
description	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
keywords	['Orthoimagery', 'Land cover', 'Geographical names', 'data set series', 'processing', 'eo:productType:/', 'eo:orbitNumber:/', 'eo:orbitDirection:/', 'eo:processingLevel:Level-1C']
associations	[{'href': 's3://EODATA/Sentinel-2/MSI/L1C/2020/09

https://resource-catalogue.demo.eoepca.org/collections/metadata:main/ite

JSON Raw Data Headers

Save Copy Collapse All Expand All Filter JSON


```
id: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
type: "Feature"
geometry:
  type: "Polygon"
  coordinates:
    0:
      0:
        0: 21
        1: 36.95
      1:
        0: 21
        1: 37.95
      2:
        0: 22.23
        1: 37.95
      3:
        0: 22.23
        1: 36.95
      4:
        0: 21
        1: 36.95
properties:
  datetime: "2020-09-30T10:57:31.000000Z"
  start_datetime: "2020-09-30T09:20:31.024Z"
  end_datetime: "2020-09-30T09:20:31.024Z"
  externalId: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  recordUpdated: "2021-12-06T16:21:09Z"
  type: "dataset"
  created: "2020-09-30T10:57:31.000000Z"
  updated: "2020-09-30T10:57:31.000000Z"
  title: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  description: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  keywords:
    0: "Orthoimagery"
    1: "Land cover"
    2: "Geographical names"
    3: "data set series"
    4: "processing"
    5: "eo:productType:/"
    6: "eo:orbitNumber:/"
    7: "eo:orbitDirection:/"
    8: "eo:processingLevel:Level-1C"
  associations:
    0:
```

Resource Catalogue Example

https://resource-catalogue.demo.eoepca.org/stac/collections/meta

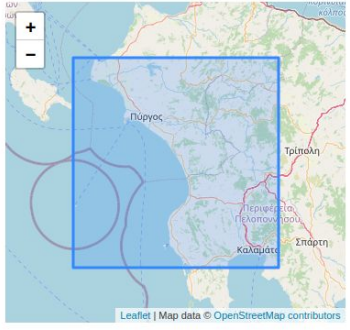
pycsw

EOEPCA Resource Catalogue

Home / Collections / EOEPCA Resource Catalogue / Items / S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE

JSON | Contact

S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE



Property	Value
datetime	2020-09-30T10:57:31.000000Z
start_datetime	2020-09-30T09:20:31.024Z
end_datetime	2020-09-30T09:20:31.024Z
externalId	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
recordUpdated	2021-12-06T16:21:09Z
type	dataset
created	2020-09-30T10:57:31.000000Z
updated	2020-09-30T10:57:31.000000Z
title	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
description	S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE
keywords	['Orthoimagery', 'Land cover', 'Geographical names', 'data set series', 'processing', 'eo:productType:/', 'eo:orbitNumber:/', 'eo:orbitDirection:/', 'eo:processingLevel:Level-1C']
extent	{'spatial': {'bbox': [[21.0, 36.95, 22.23, 37.95]], 'crs': 'http://www.opengis.net/def/crs/OGC/1.3/CRS84'}}

https://resource-catalogue.demo.eoepca.org/stac/collections/metadata:ma

JSON Raw Data Headers

Save Copy Collapse All Expand All Filter JSON


```
id: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
type: "Feature"
geometry:
  type: "Polygon"
  coordinates:
    0:
      0:
        0: 21
        1: 36.95
      1:
        0: 21
        1: 37.95
      2:
        0: 22.23
        1: 37.95
      3:
        0: 22.23
        1: 36.95
      4:
        0: 21
        1: 36.95
properties:
  datetime: "2020-09-30T10:57:31.000000Z"
  start_datetime: "2020-09-30T09:20:31.024Z"
  end_datetime: "2020-09-30T09:20:31.024Z"
  externalId: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  recordUpdated: "2021-12-06T16:21:09Z"
  type: "dataset"
  created: "2020-09-30T10:57:31.000000Z"
  updated: "2020-09-30T10:57:31.000000Z"
  title: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  description: "S2A_MSIL1C_20200930T092031_N0209_R093_T34SEG_20200930T105731.SAFE"
  keywords:
    0: "Orthoimagery"
    1: "Land cover"
    2: "Geographical names"
    3: "data set series"
    4: "processing"
    5: "eo:productType:/"
    6: "eo:orbitNumber:/"
    7: "eo:orbitDirection:/"
    8: "eo:processingLevel:Level-1C"
extent:
  spatial:
```

Resource Catalogue Examples

Launcher | 04 Resource Catalogue.ipyn ●

Markdown

```
[11]: #bbox_query = BBox([37.8, 23.4, 38.8, 24.5])
      bbox_query = BBox([37, 13.9, 37.9, 15.1])

[12]: begin = PropertyIsGreaterThanOrEqualTo(propertyname='apiso:TempExtent_begin', literal='2021-04-02 00:00')

[13]: end = PropertyIsLessThanOrEqualTo(propertyname='apiso:TempExtent_end', literal='2021-04-03 00:00')

[14]: cloud = PropertyIsLessThanOrEqualTo(propertyname='apiso:CloudCover', literal='20')

[15]: filter_list = [
          And(
              [
                  bbox_query,  # bounding box
                  begin, end,  # start and end date
                  cloud        # cloud
              ]
          )
      ]
```

The filter is then applied to the GetRecords request and results are shown:

```
[17]: csw.getrecords2(constraints=filter_list, outputschema='http://www.isotc211.org/2005/gmd')
      csw.results

[17]: {'matches': 1, 'returned': 1, 'nextrecord': 0}

[18]: selected_record = list(csw.records)[0]

[19]: for rec in csw.records:
          print(f'identifier: {csw.records[rec].identifier}\ntype: {csw.records[rec].identification.identtype}\nt
```

```
identifier: S2B_MSIL1C_20210402T095029_N0300_R079_T33SVB_20210402T121737.SAFE
type: dataset
title: S2B_MSIL1C_20210402T095029_N0300_R079_T33SVB_20210402T121737.SAFE
```

Launcher | 04 Resource Catalogue.ipyn ●

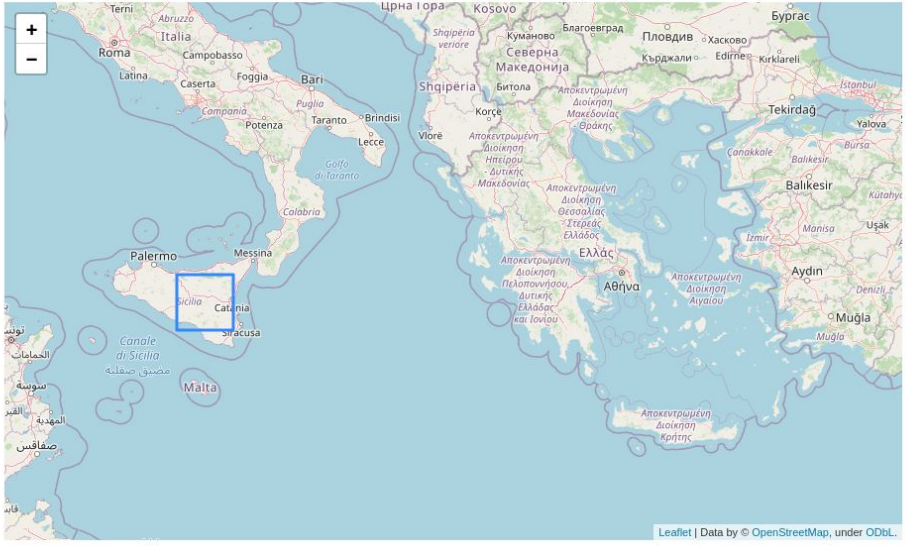
Markdown | Python 3

```
[ ]: for ref in rec.references:
         url = ref['url']
         if 'WCS' in url:
             print(msg(geolink=sniff_link(url), **ref))
             break
```

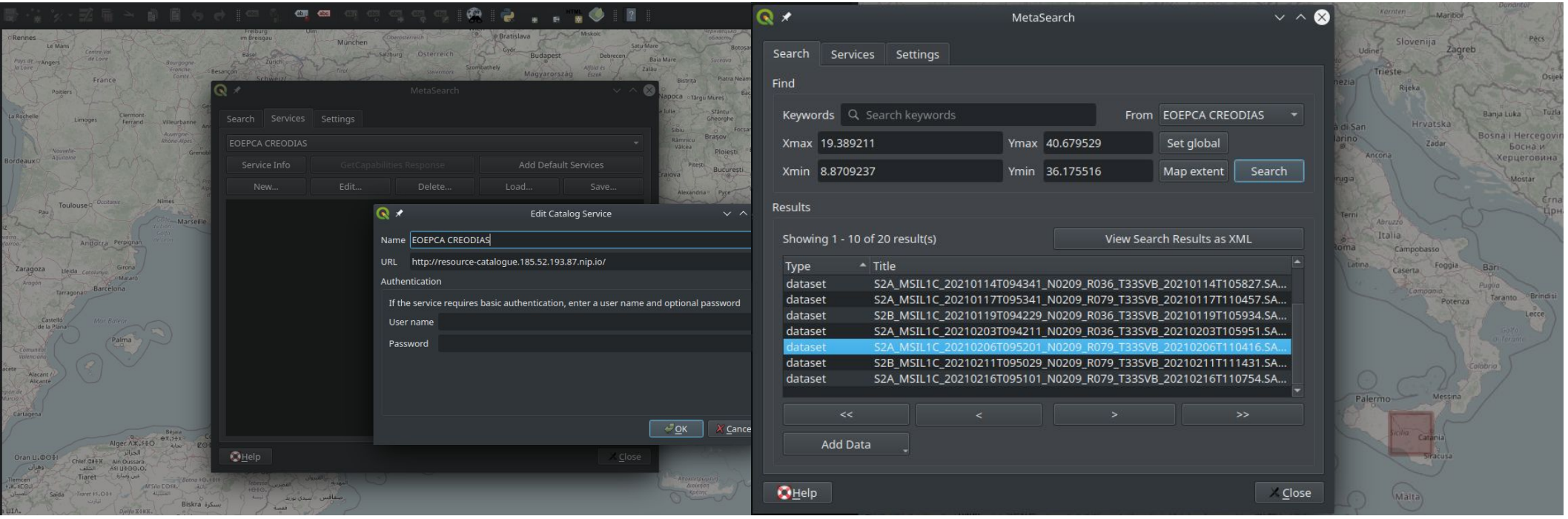
Finally we demonstrate how to show the record footprint on a map, using the Folium Python library:

```
[32]: m = folium.Map(location=[38, 20], zoom_start=6, tiles='OpenStreetMap')
      folium.Rectangle(bounds=[[float(rec.bbox.miny), float(rec.bbox.minx)], [float(rec.bbox.maxy), float(rec.bbox.maxx)]]).
      m
```

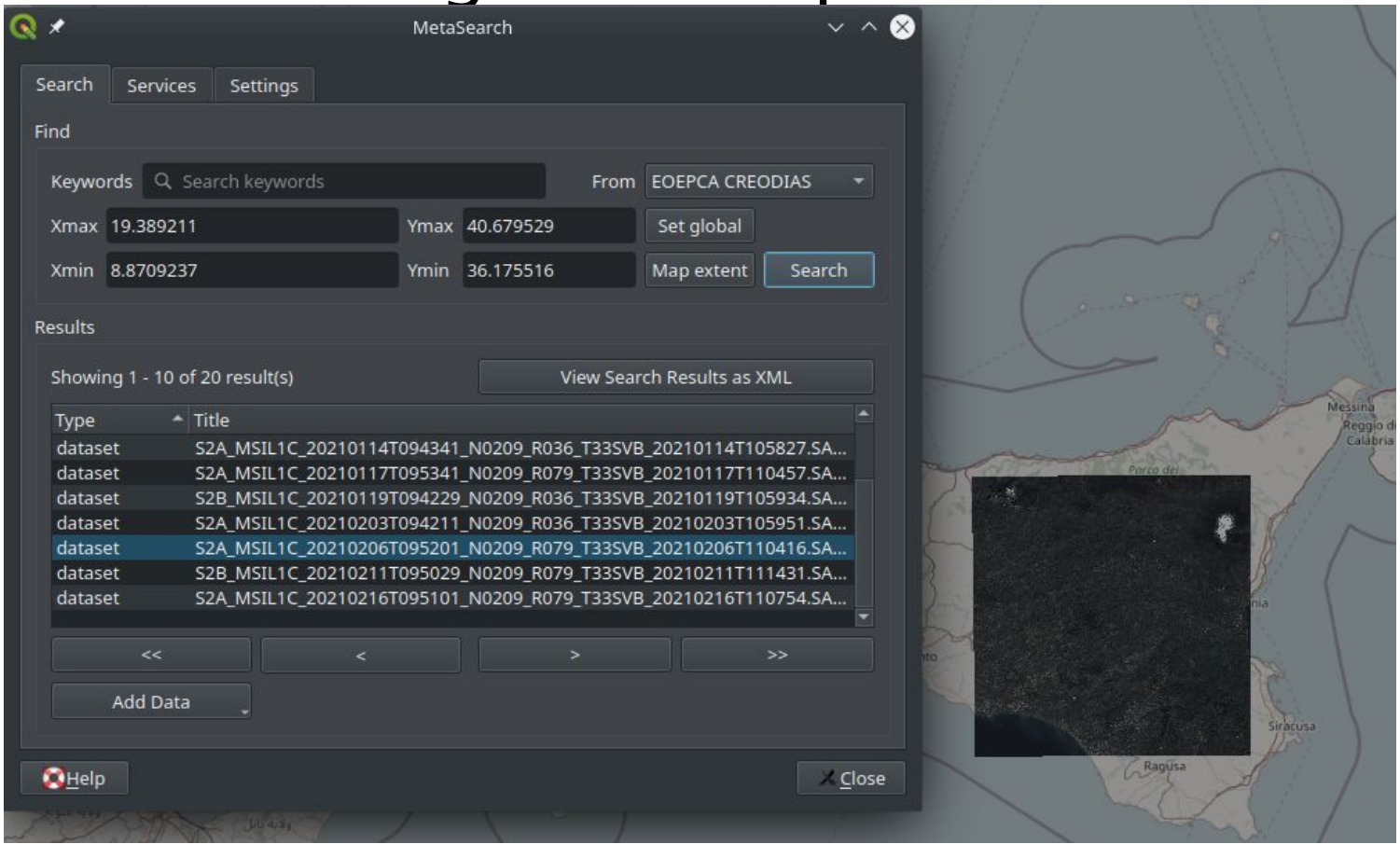
[32]:



Resource Catalogue Examples



Resource Catalogue Examples



Data Access Service Overview

- View Server (EOxServer as core)
- Flexible WMS viewing interface
  - raster expressions, outlines, masking, property filtering
- Performance optimized WM(T)S cached viewing

Data Access Service Overview

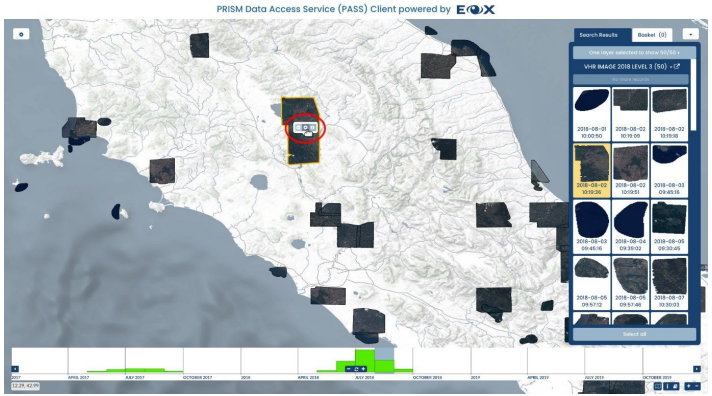
- Download interfaces
  - WCS + EO Application Profile
  - DSEO
- OGC OpenSearch catalog interface
  - Geo Extension
  - Time Extension
  - EO Extension
  - CQL filtering

Data Access Ingestion

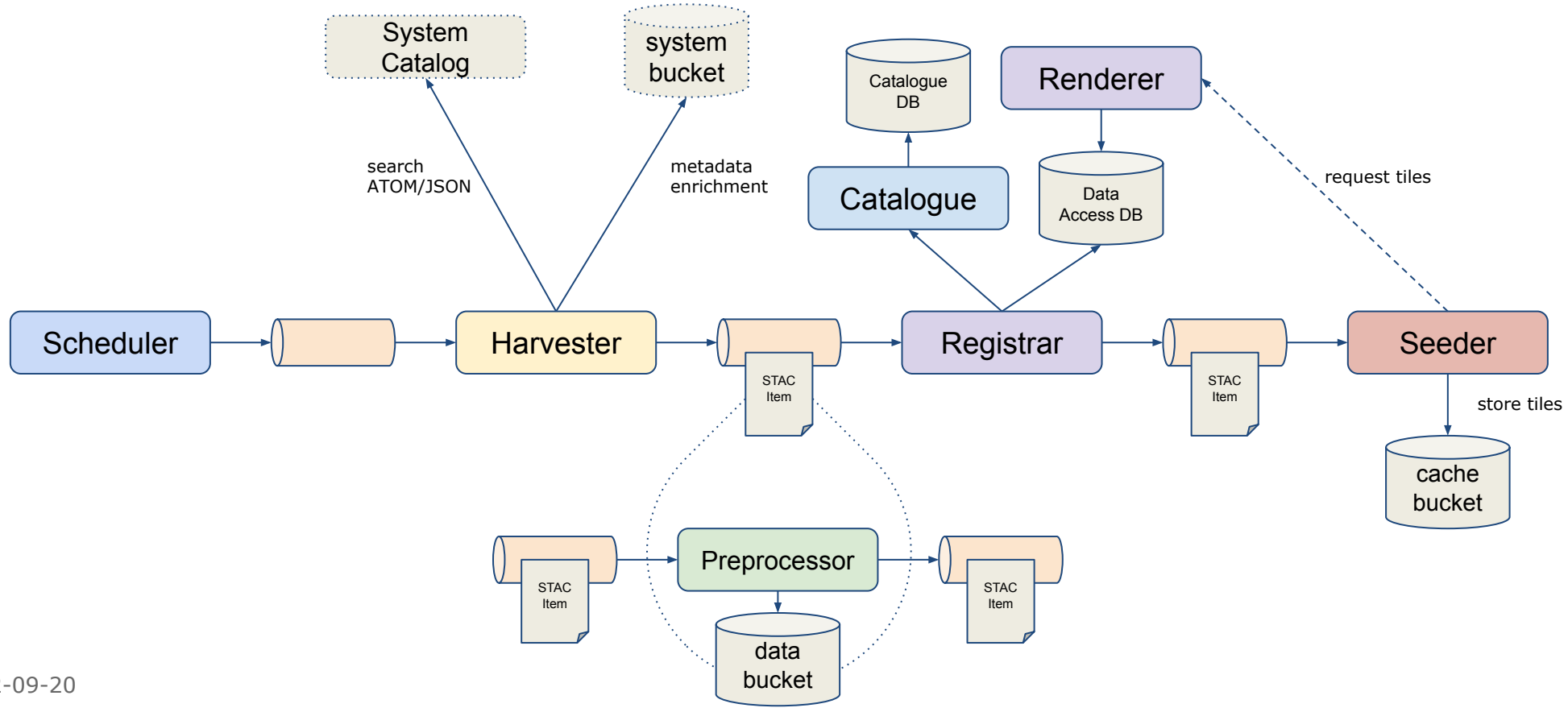
- Harvesting from System catalog
- Metadata enrichment
- Export to STAC Item
- Registration into Data Access and Resource Catalog

Data Access Service & Ingestion Components

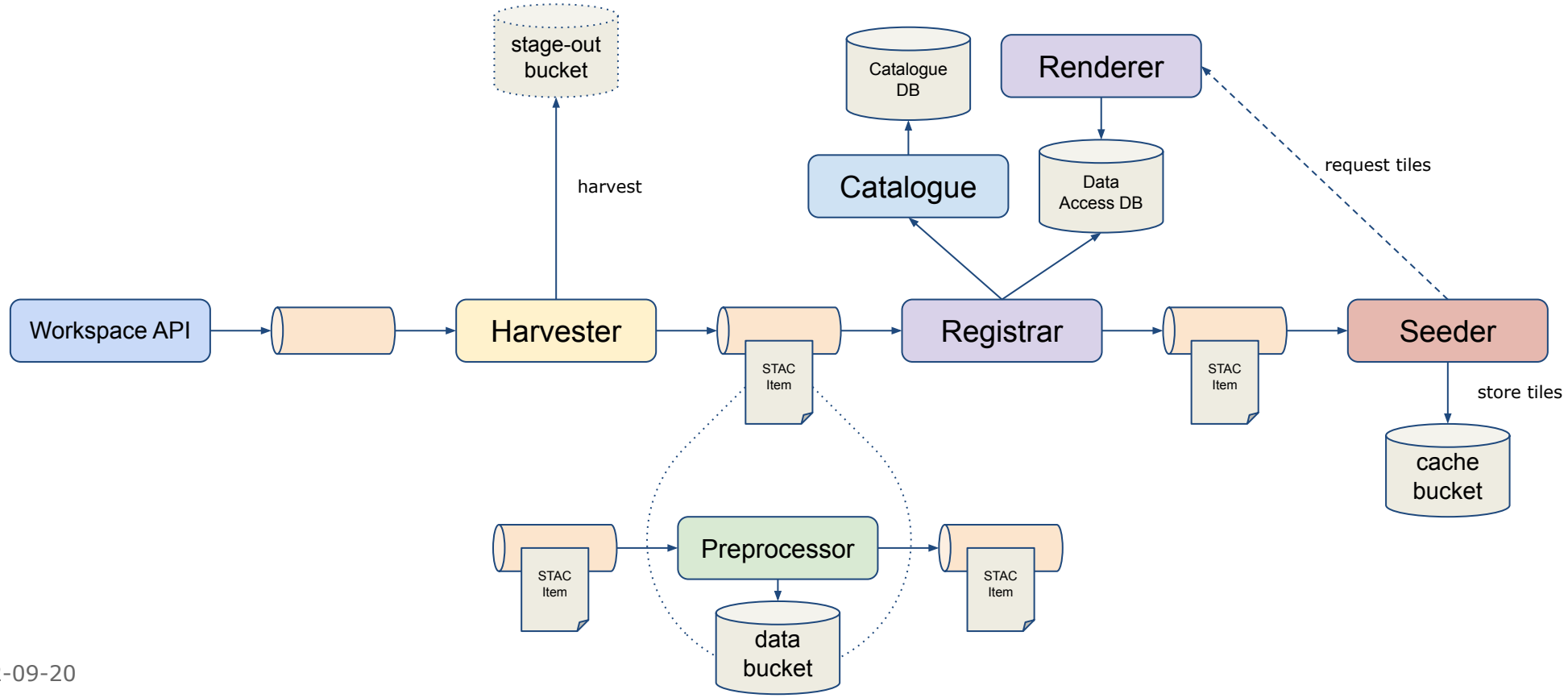
- Database - PostgreSQL
- Renderer - EOxServer
- Cache - Mapcache
- Registrar - Python + EOxServer
- Harvester - Python
- Redis queues
- Webclient based on EOxC
- Elasticsearch/Fluentd/Kibana logging stack



Data Access Ingestion



Data Access Ingestion - Workspace



Harvesting configuration

- Several harvesters can be configured

```
harvesters:
 - name: Creodias-Opensearch
   resource:
     url: https://finder.creodias.eu/resto/api/collections/Sentinel2/describe.xml
     type: OpenSearch
     format_config:
       type: 'application/json'
       property_mapping:
         start_datetime: 'startDate'
         end_datetime: 'completionDate'
         productIdentifier: 'productIdentifier'
     query:
       time:
         property: sensed
         begin: 2019-09-10T00:00:00Z
         end: 2019-09-11T00:00:00Z
       collection: null
       bbox: 14.9,47.7,16.4,48.7
   filter: {}
   postprocess:
     - type: harvester_eoepca.postprocess.CREODIASOpenSearchSentinel2Postprocessor
   queue: register
```

Harvesting configuration

- `resource`: defines from where shall be harvested
- `filter`: filter harvested items using CQL2-JSON
- `postprocess`:
  - apply postprocessing (Python script)
  - transformation to STAC if not already
  - metadata enrichment

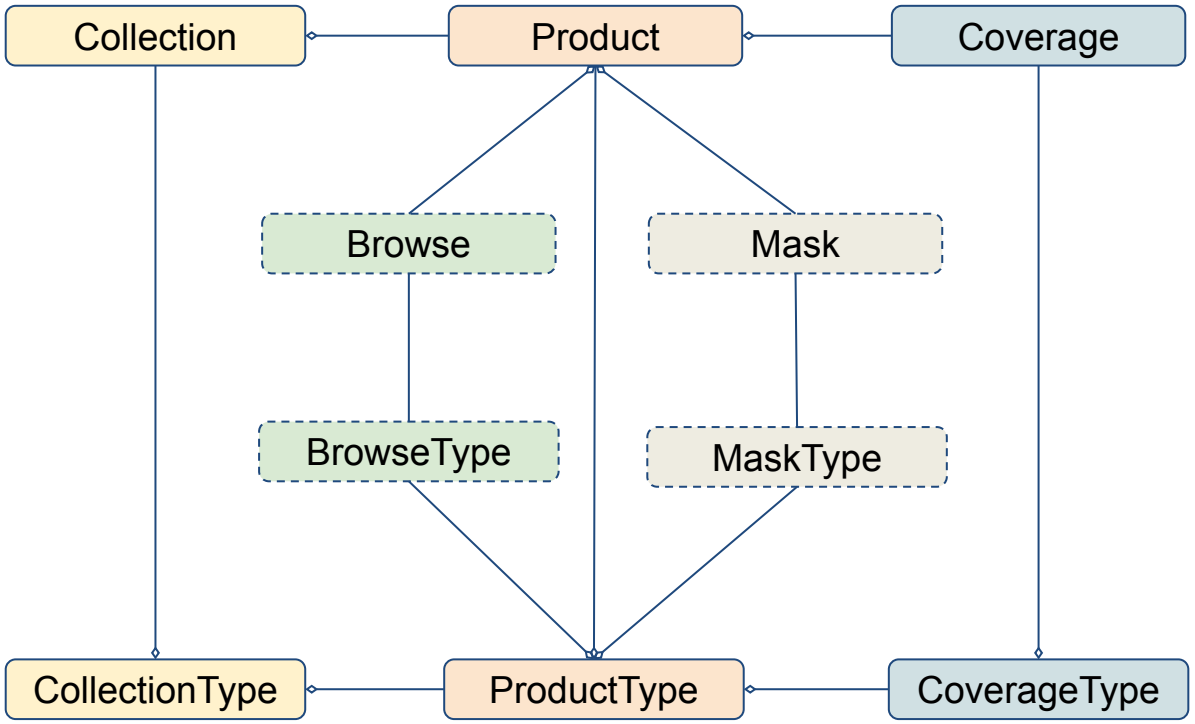
```python
class MyPostprocessor(Postprocessor):
    def postprocess(self, item: dict) -> dict:
        ...
```

- `queue`: output queue

Data Access configuration

- View Server can be used with rigid type system
  - Products
    - main Record item
  - Coverages
    - sub-item of Products (rel OGC Coverges)
  - Browses
    - visual representation of a Product
    - either materialized or virtual
  - Masks
  - Collections

Data Access configuration



Data Access configuration

- Helm chart values
- `global` values:
  - `productTypes`
  - `collections`
- and `registrar` specific values

Data Access ProductType configuration

- Product type definition:

```
productTypes:
 - name: S2MSI1C
   filter:
     s2:product_type: S2MSI1C
   collections:
     - S2L1C
   metadata_assets: []
   coverages:
     S2L1C_B01:
       assets:
         - B01
   ...
```

Data Access ProductType configuration

- Browse setup:

```
...
defaultBrowse: TRUE_COLOR
browses:
  TRUE_COLOR:
    asset: visual
    red:
      expression: B04
      range: [0, 4000]
      nodata: 0
    green:
      expression: B03
      range: [0, 4000]
      nodata: 0
    blue:
      expression: B02
      range: [0, 4000]
      nodata: 0
```

```
browses:
...
  NDVI:
    grey:
      expression: (B08-B04)/(B08+B04)
      range: [-1, 1]
masks:
  clouds:
    validity: false
```

Data Access ProductType configuration

- `filter`: when registering only matching products use this product type
- `collections`: place this product in the collection
- `coverages`: all coverages to be created for the product and the asset name to find it in the STAC Item
- `browses`:
  - the asset name of the browse and/or
  - the red, green, blue or greyscale sources or expressions
  - value ranges to stretch

Data Access Collection configuration

- Collection definition:

```
collections:
  S2L1C:
    product_types:
      - S2MSI1C
    coverage_types:
      - S2L1C_B01
      - S2L1C_B02
      - S2L1C_B03
      - ...
```

Data Access Collection configuration

- `product_types`: product types that can be inserted into this collection
- `coverage_types`: coverage types that can be inserted into this collection

Registration configuration

```
config:
  defaultBackends:
    - path: registrar_pycsw.backend.ItemBackend
      kwargs:
        repository_database_uri: postgresql://postgres:mypass@resource-catalogue-db/pycsw
        ows_url: https://data-access.develop.eoepca.org/ows
  defaultSuccessQueue: seed_queue
```

Registration configuration

```
disableDefaultRoute: true
routes:
  items:
    path: registrar.route.stac.ItemRoute
    queue: register_queue
    replace: true
    backends:
      - path: "registrar.backend.eoxserver.ItemBackend"
        kwargs:
          instance_base_path: "/var/www/pvs/dev"
          instance_name: "pvs_instance"
          product_types: []
          auto_create_product_types: True
      - path: "registrar_pycsw.backend.ItemBackend"
        kwargs:
          repository_database_uri: "postgresql://postgres:mypass@resource-catalogue-db/pycsw"
          ows_url: "https://data-access.{{ workspace_name }}.develop.eoepca.org/ows"
          public_s3_url: "https://cf2.cloudferro.com:8080/{projectid}:{bucket}"
```

Registration configuration

```
collections:
  path: registrar.route.stac.CollectionRoute
  queue: register_collection_queue
  replace: true
  backends:
    - path: registrar_pycsw.backend.CollectionBackend
      kwargs:
        repository_database_uri : postgresql://postgres:mypass@resource-catalogue-db/pycsw

ades:
  path: registrar.route.json.JSONRoute
  queue: register_ades_queue
  replace: true
  backends:
    - path: registrar_pycsw.backend.ADESBackend
      kwargs:
        repository_database_uri : postgresql://postgres:mypass@resource-catalogue-db/pycsw

application:
  path: registrar.route.json.JSONRoute
  queue: register_application_queue
  replace: true
  backends:
    - path: registrar_pycsw.backend.CWLBackend
      kwargs:
        repository_database_uri : "postgresql://postgres:mypass@resource-catalogue-db/pycsw"
        ows_url: "https://data-access.{{ workspace_name }}.develop.eoepca.org/ows"
        public_s3_url : "https://cf2.cloudferro.com:8080/{projectid}:{bucket}"
```

Registration configuration

- “Routes”
  - Listens on a specific queue
  - Parses to a specific type (e.g.: STAC Item)
  - Connected to backends (e.g.: pycsw)
  - Modes (register, replace, deregister)
  - Configurable output queue
  - Default Route (additional backends)

Seeder Configuration

- Re-uses cache configuration
- `minzoom`/`maxzoom`

Renderer Configuration

- Re-uses global ProductType setup
- EO-WCS:
  - Collections -> advertised DatasetSeries
  - Products -> non-advertised DatasetSeries
  - Coverages -> non-advertised Coverages
  - Typical flow:
    - `GetCapabilities` -> DatasetSeries
    - `DescribeEOCoverageSet` -> Coverages
    - `GetCoverage`

Renderer Configuration

- EO-WMS:
  - Collections: advertised layer structure
  - Products: non-advertised layer structure
  - Coverage: non-advertised layer structure
- Basic layers:
  - “`<name>`” -> default rendering
  - “`<name>__outlines`” -> rendered footprint
  - “`<name>__outlined`” -> default rendering with imposed footprint

Renderer Configuration

- Collection/Products:
  - "`<name>__<browse>`": specific visualization
    - e.g: "`S2L1C__NDVI`"
  - "`<name>__<mask>`": polygon mask
    - e.g: "`S2L2A__clouds`"
  - "`<name>__masked_<mask>`": default visualization with masks subtracted

Renderer Configuration

- Coverages:
  - `dim_bands` parameter for RGB composition
    - e.g: …`&dim_bands=B08,B04,B03&...`
  - `dim_ranges` parameter
    - e.g: …`&dim_range=0 4000&...`

Renderer Configuration

- Additional parameters:
  - `cql`: Allows to pass CQL filters
    - e.g: …`&cql=cloudCover < 10&...`
  - `sortBy`: Allows to sort rendered images
    - e.g: …`&sortBy=cloudCover A&...`

Renderer Configuration

- OpenSearch
- Automatically exposed as set of endpoints
- `/opensearch` -> root OSDD
- `/opensearch/<format>` -> collection level search
- `/opensearch/collections/<collection>` -> collection OSDD
- `/opensearch/collections/<collection>/<format>` -> product level search

Cache/Client Configuration

```yaml
layers:
  - id: S2L1C
    title: Sentinel-2 Level 1C True Color
    abstract: Sentinel-2 Level 2A True Color
    displayColor: '#eb3700'
    grids:
      - name: WGS84
        zoom: 13
    parentLayer: S2L1C
    search:
      histogramBinCount: 15
      histogramThreshold: 80
  - id: S2L1C__TRUE_COLOR
    title: Sentinel-2 Level 1C True Color
    abstract: Sentinel-2 Level 2A True Color
    grids:
      - name: WGS84
        zoom: 13
    parentLayer: S2L1C
```

Cache/Client Configuration

- `global.layers`
- Metadata: `id`, `title`, `abstract`
- `displayColor`: used in the client
- `grids`: what grids shall be cached and until which zoomlevel
- `parentLayer`: to build layer hierarchies
- `search`: search settings
- `global.storage.cache`:
  - storage configuration
  - cache bucket credentials as secret

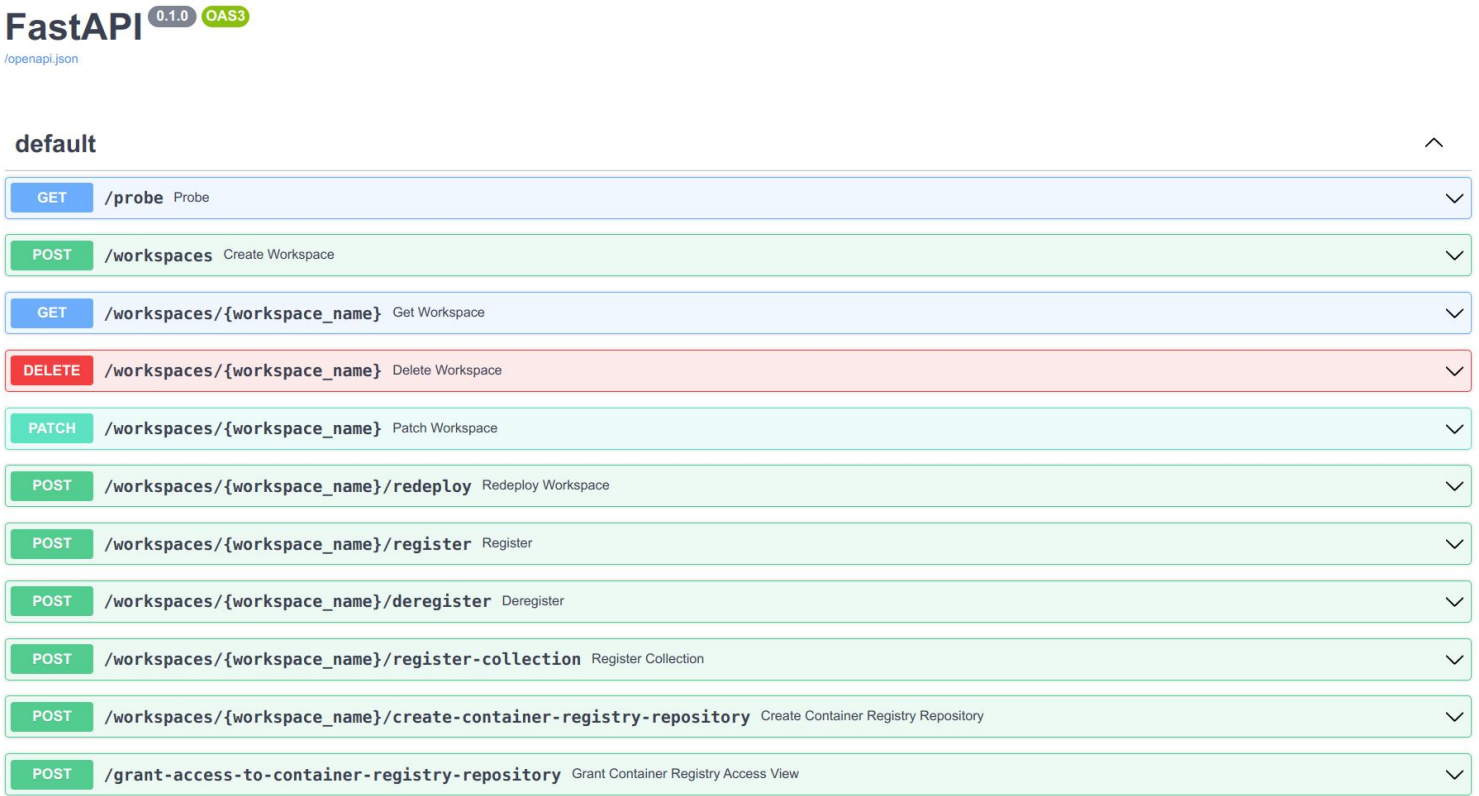
Cache Configuration

- Endpoints:
  - `/cache/` -> main entry point
  - `/cache/wmts` -> WMTS
  - `/cache/wms` -> WMS endpoint

User Workspace

- EOEPCA Model
  - Object storage bucket
  - Data Access Service
  - Resource Catalog with federated system catalog
  - Deployment scenario(s) up to operator
- Workspace API based on FastAPI
  - create, delete, etc.
  - using “Bucket” claims via K8s CRD & K8s Secret
  - register data & processes
- Bucket operator for OpenStack

User Workspace



User Workspace Customization

- Configuration options in detail here
- Central configs:
  - `workspaceChartsConfigMap`
    References a config map containing HelmReleases which define the user workspace functionality
  - `s3Endpoint`, `s3Region`
    Bucket server location
  - `harborUrl`, `harborUsername`, `harborPassword`
    Access for workspace api to harbor (container registry)

Harbor (container registry)

- Installed via helm release
- Central configs:
  - `harborAdminPassword`
    Change in interface after first install and configure in workspace api
  - `storageClass`
    Set an appropriate storage class for all harbor services

Summary

- Open Standards (OGC, ISO)
- Free and Open Source (FOSS)
  - Core components
  - Reference implementation
  - Geospatial (FOSS4G)
- Best of breed Python geospatial components
- Download, configure, and run
  - https://github.com/EOEPCA/eoepca
- Open communities
- Open to contributions

EOEPCA Resource Management

Thanks for your attention!

EOX IT Services https://eox.at

EOfarm P.C. http://eofarm.com

EOEPCA Operators demo 2022-09-20