



Task 4.2: Common NIVA API

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NIVA meeting – 12/05/2020



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Main Concept of Common API

- ✓ Earth Observation API:
 - ✓ Provide a unique API layer as broker of EO based services based on OpenEO
 - ✓ Integrate NIVA available EO based services such as Sen4CAP
 - ✓ Provide a common approach to evolve the common API layer by incrementally adding new EO services over time
- ✓ Traffic Lights API:
 - ✓ Provide access to different information (EO, FMIS ...)
 - ✓ Provide a standard layer NIVA data model (semantics) specifications
- ✓ Linked Data AgroEnvironmental API
 - ✓ Provide an AgroEnvironmental Linked Data end-point aggregating data coming from different sources (LPIS, Crop Type, Farm Registry ...)
 - ✓ Facilitate the machine-to-machine interaction



Earth Observation API

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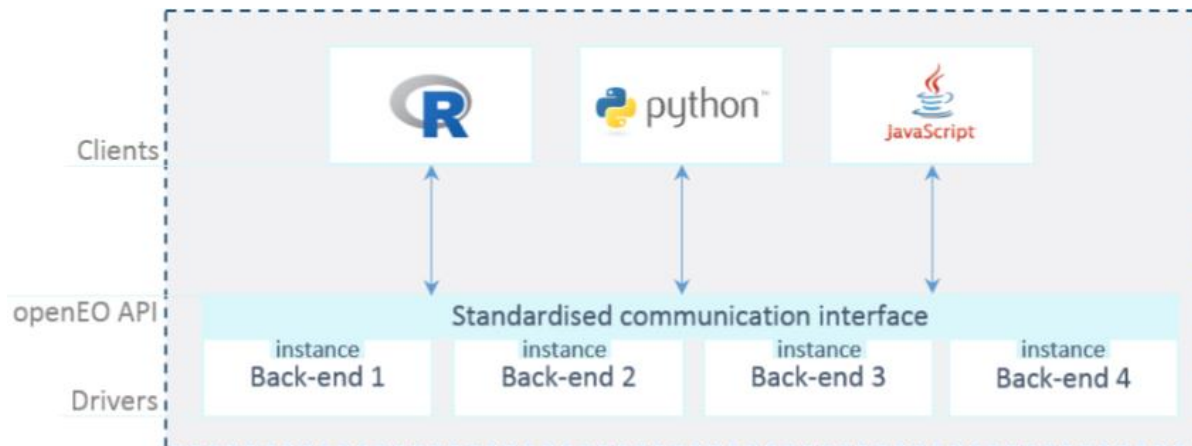
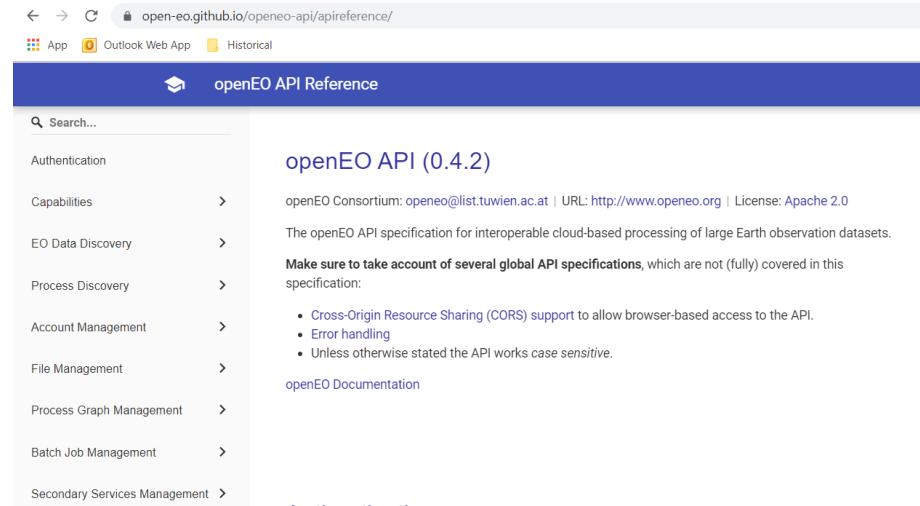
Earth Observation API Services for CAP

Data and products necessary for CAP needs are at different level of complexity; the aim is to access existing and other under development external systems and internal components (e.g. those from UCs) and to categorize available data/products for an easy use

- Base L3 products markers (Sen4CAP, any other marker generator)
 - Sentinel 1 weekly averaged markers and features
 - Sentinel 2 derived spectral indexes, FAPAR, LAI
 - ...
- Advanced L4 products markers (Sen4CAP, any other marker generator)
 - Grassland Mowing, Crop Type
 - Harvesting,
- Processing services:
 - Markers calculation for parcels
 - Anomaly detection (analysis of time series, inter-field, intra-field analysis...)
 -

EO Broker API

- It is based on OpenEO specification
- Allow to discover:
 - Data
 - Processing services
 - User Defined Functions
- Allow to consume such services
- It implements also mechanism to access subscription based services



OpenEO API specification

- The openEO API defines a HTTP API that lets cloud back-ends with large Earth observation datasets communicate with front end analysis applications in an interoperable way.
- As an overview, the openEO API specifies how to
 - discover which Earth observation data and processes are available at cloud back-ends,
 - execute (chained) processes on back-ends,
 - run user-defined functions (UDFs) on back-ends where UDFs can be exposed to the data in different ways,
 - download (intermediate) results, and
 - manage user content including billing.
- The API is defined as an [OpenAPI 3.0](#) YAML file.

<https://openeo.org/documentation/1.0/developers/api/reference.html>

OpenEO Advantages

- Specification is open to contribution and it still support several use cases
- Data catalogue is done using STAC (Spatio-Temporal Asset Catalogue) specification which is generic enough to include also non-EO data (e.g. Geotagged Photos)
- It embraces the micro-service paradigm allowing a sustainable development of functions
- Decouple the UI from the back-end and provide a common interface to different platforms (there are already 5 DIAS and many other EO platform)

OpenEO API Example 1 (Spectral Index)

- Example: Calculate custom spectral index by giving a specific UDF (e.g. `normalized_difference`)

Arguments such as collection and spatio-temporal interval

Process description: Selected Band, Formula

```
{
  "loadcut": {
    "process_id": "load_collection",
    "arguments": {
      "id": "sentinel-2",
      "spatial_extent": {
        "west": {
          "variable_id": "spatial_extent_west"
        },
        "east": {
          "variable_id": "spatial_extent_east"
        },
        "north": {
          "variable_id": "spatial_extent_north"
        },
        "south": {
          "variable_id": "spatial_extent_south"
        }
      },
      "temporal_extent": {
        "start": "2018-01-01",
        "end": "2018-02-01"
      }
    }
  },
  "ndvii": {
    "process_id": "ndvii",
    "arguments": {
      "data": {
        "from_node": "loadcut"
      }
    }
  },
  "reduce": {
    "process_id": "reduce",
    "arguments": {
      "data": {
        "from_node": "ndvii"
      }
    },
    "dimension": "t",
    "reducer": {
      "callback": {
        "max": {
          "process_id": "max",
          "arguments": {
            "data": {
              "from_parameter": "data"
            }
          },
          "result": true
        }
      }
    }
  },
  "result": true
}
}
```

JSON Request



File API: Cloud Storage (e.g. S3)

Secondary Services: OGC Services like WMS, WCS, WFS

Direct Access: Download

Different Output

OpenEO API Example 1 (Zonal Stats)

- Example: Calculate zonal stats on existing raster layer and store the results using the NIVA information model

Collection details
and spatio-
temporal interval

Arguments
such as Parcels
GeoJSON

Process
description: List
of computation
or services

```
{
  "processes": [
    {
      "id": "load_collection",
      "arguments": {
        "collection": "Sentinel2",
        "temporal_extent": {
          "type": "temporal_extent",
          "start": "2019-01-01",
          "end": "2019-01-31"
        }
      },
      "metadata": {
        "type": "load_collection"
      }
    },
    {
      "id": "load_datacube",
      "arguments": {
        "collection": "Sentinel2",
        "temporal_extent": {
          "type": "temporal_extent",
          "start": "2019-01-01",
          "end": "2019-01-31"
        }
      },
      "metadata": {
        "type": "load_datacube"
      }
    },
    {
      "id": "load_datacube",
      "arguments": {
        "collection": "Sentinel2",
        "temporal_extent": {
          "type": "temporal_extent",
          "start": "2019-01-01",
          "end": "2019-01-31"
        }
      },
      "metadata": {
        "type": "load_datacube"
      }
    },
    {
      "id": "load_datacube",
      "arguments": {
        "collection": "Sentinel2",
        "temporal_extent": {
          "type": "temporal_extent",
          "start": "2019-01-01",
          "end": "2019-01-31"
        }
      },
      "metadata": {
        "type": "load_datacube"
      }
    }
  ]
}
```

JSON Request



File API: Cloud Storage
(e.g. S3)

Secondary Services: OGC
Services like WMS, WCS,
WFS

Different Output

Earth Observation API – Microservices (1)

	Service	Description
1	mean and standard deviation of 8 reflectance S2 bands	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
2	mean and standard deviation of NDWI	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
3	mean and standard deviation of pixel brightness	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
4	weekly backscatter mosaics, grouped by orbit type and polarization: $ASC/DESC \times VV/VH/VV \div VH$	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
5	weekly coherence mosaics, grouped by orbit type and polarization: $ASC/DESC \times VV/VH$	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
6	temporal features from the weekly temporal backscatter mosaics: mean value and coefficient of variation $\times ASC/DESC \times VV/VH/VV \div VH$	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
7	the standard deviation across the season (VV/VH) from the weekly coherence mosaics	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
8	the minimum coherence value across each month (VV/VH) from the weekly coherence mosaics	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
9	mean coherence value across each month (VV/VH) from the weekly coherence mosaics	Markers calculated at parcel level on the basis of Sen4CAP available pre-calculated data
10	Sentinel L2A true color – imagery	Bounding box or parcel-clipped imagery for a specific date/time. Available on pre-processed data.
11	Sentinel L2A false color – imagery	Bounding box or parcel-clipped imagery for a specific date/time. Available on pre-processed data.
12	Sentinel 2 L3A NDVI	Parcel-level time-series statistics (average, mean, min, max; for each date/time) Available on Sen4CAP pre-calculated data.

Earth Observation API – Microservices (2)

	Service	Description
13	Sentinel 2 L3A NDVI – imagery	Bounding box or parcel-clipped imagery for a specific date/time. Available on pre-processed data.
14	Sentinel 2 L3A LAI	Parcel-level time-series statistics (average, mean, min, max; for each date/time) Available on Sen4CAP pre-calculated data.
15	Sentinel 2 L3A LAI - imagery	Bounding box or parcel-clipped imagery for a specific date/time. Available on pre-processed data.
16	Sentinel 2 L3A FAPAR	Parcel-level time-series statistics (average, mean, min, max; for each date/time) Available on Sen4CAP pre-calculated data.
17	Sentinel 2 L3A FAPAR – imagery	Bounding box or parcel-clipped imagery for a specific date/time. Available on pre-processed data.
18	Crop type mapping	Products (Sen4CAP does not refer to these as markers) calculated at parcel level on the basis of Sen4CAP available pre-calculated data
19	Grassland mowing detection	Products (Sen4CAP does not refer to these as markers) calculated at parcel level on the basis of Sen4CAP available pre-calculated data
20	Agricultural practices monitoring	Products (Sen4CAP does not refer to these as markers) calculated at parcel level on the basis of Sen4CAP available pre-calculated data
21	Interfield	Analysis of anomalies in the time-series of pixels of a parcel
21	Intrafield	Analysis of anomalies at scale using reference data



Traffic Lights API

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Traffic Lights component API

- Provide an umbrella API capable to provide heterogeneous information from multiple sources that adhere to NIVA data model (semantics) specifications
- Use a standardised OGC compatible API. Information sources examples include:
 - Multiple EO classification engines (e.g. Sen4CAP)
 - geotagged photos applications
 - farm management information systems.

Traffic Lights component API - Microservices

	Service	Description
1	Crop type provision	Crop type classification information (e.g. Sen4CAP) registered with this common component as parcels attributes
2	Land type provision	Land type classification information (e.g. Sen4CAP) registered with this common component as parcels attributes
4	Selected Farm calendar entries provision	Farm management information such as calendar data will be provided as parcel's attribute- metadata
5	Geotagged photos provision	Geotagged photo applications that are registered with this common component.



AgroEnvironmental Linked Data API

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AgroEnvironmental Linked Data API

- Publication of Linked Data API for different sources
- Previously Open Databases
- NIVA Databases as:
 - Crop type declarations
 - Parcels
 - Farm Registry
 - LPIS
- External Databases, models and ontologies

AgroEnvironmental Linked Data API

- Select pre-existing ontologies
- Complete a NIVA agroenviromental data model
- Clean the data to remove inconsistencies or data problems
- Populate/publish de Linked Data Endpoint through ETL process

Next Steps

- Finalize D4.2 Technical Note
- Define a plan for the development of the common components including:
 - OpenEO Broker API
 - Back-end EO API services (Data, Processing) integration
 - Traffic Lights API services integration
 - Linked Data API services integration
 - Client Libraries (Python) to facilitate the integration into UC as open source library

THANK YOU!




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