



## STAC – how to find and use spatiotemporal data easily?

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Our special expertise includes for instance research infrastructures, interoperability, and digital transformation



Turnover in 2022  
**64**M€



One of the world's most eco-efficient datacenter in Kajaani



Non-profit state enterprise with special tasks owned by the state of Finland **70 %** and Finnish higher education institutions **30 %**



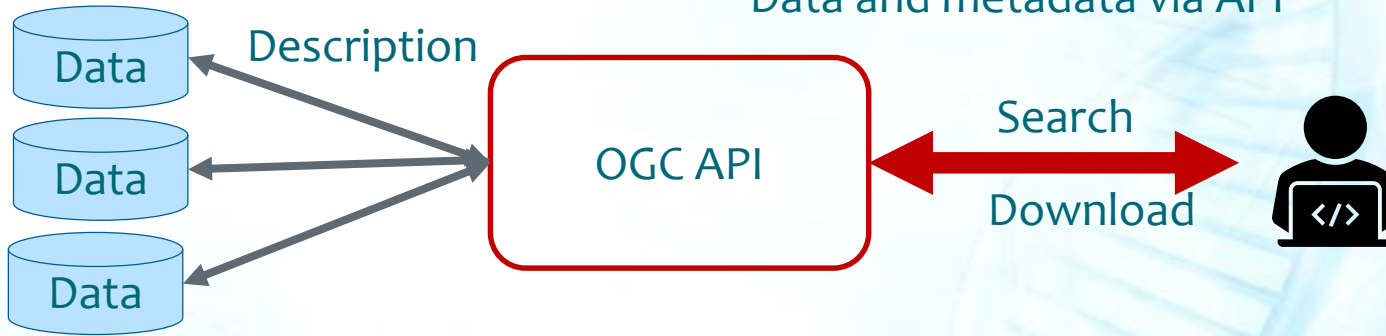
Approx.  
**618**  
employees in  
2023

# STAC - Spatio-Temporal Asset Catalog

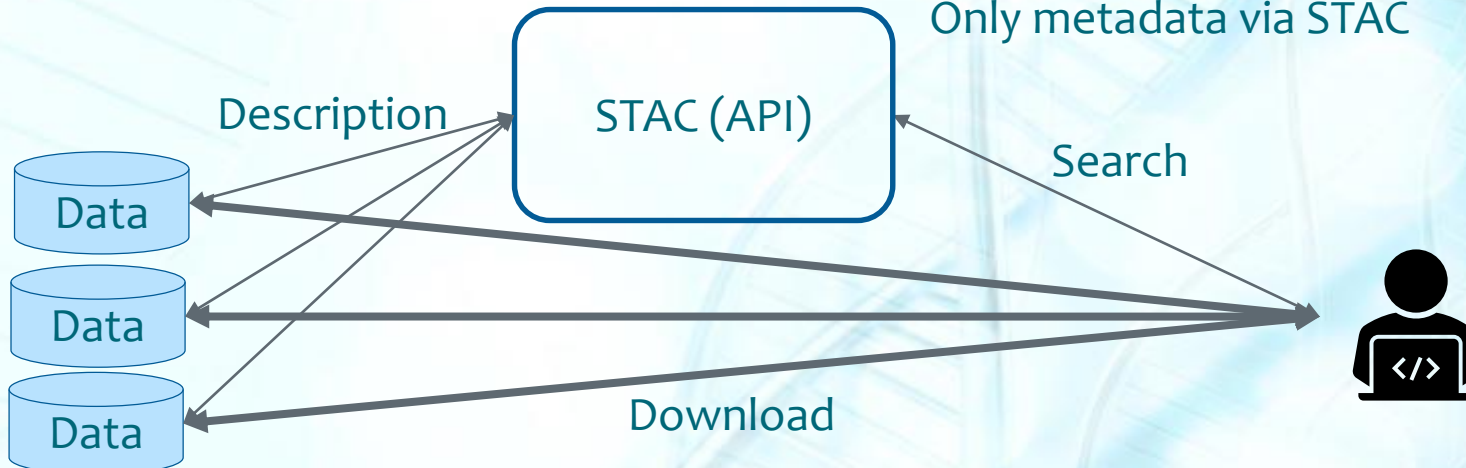
- Started in 2018, rapidly developing
- New de facto metadata and search standard
  - May become an OGC standard in the future.
- Describes datasets at the level of individual files.
- It is most commonly used for remote sensing data, but it is suitable for any data with **time** and **location** information.
- Users: ESA, USGS, Microsoft Planetary computer, Google Earth Engine,
  - In Finland: FMI and CSC.



## Data and metadata via API

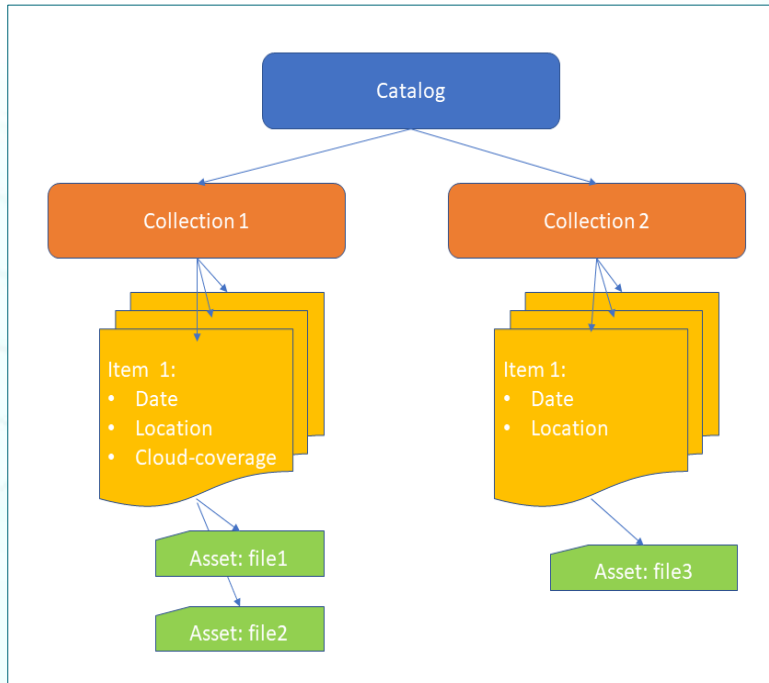


## Only metadata via STAC





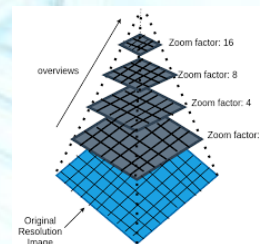
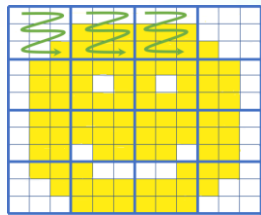
# STAC terminology



- Luettelo
- Kokoelma
- Tuote
- Resurssi

# Cloud-optimized file formats

- Enables partial loading of data
  - Only loads data for a specific area
  - Generalized version of the data is available
- Rasters: Cloud-Optimized GeoTiff (COG)
- Point clouds: Cloud-Optimized Point Clouds (COPC)
- Vectors: ?



# Static STAC = linked JSON files

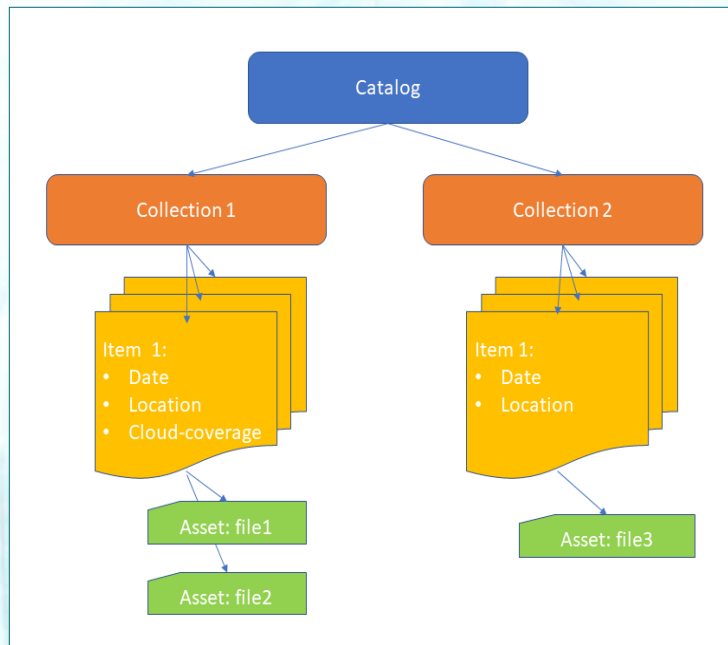
```
https://paituli-test.csc.fi/geoserver/ogc/stac/?f=application%2Fjson
// 20230428120659
// https://paituli-test.csc.fi/geoserver/ogc/stac/?f=application%2Fjson
{
  "title": "Paituli STAC",
  "description": "Provides interoperable access, following ISO/OGC interface guidelines",
  "links": [
    {
      "href": "https://paituli-test.csc.fi/geoserver/ogc/stac/?f=application%2Fyaml",
      "rel": "alternate",
      "type": "application/x-yaml",
      "title": "This document as application/x-yaml"
    },
    {
      "href": "https://paituli-test.csc.fi/geoserver/ogc/stac/?f=application%2Fjson",
      "rel": "self",
      "type": "application/json",
      "title": "This document"
    },
    {
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      "rel": "alternate",
      "type": "text/html",
      "title": "This document as text/html"
    }
  ],
  {
    "href": "https://paituli-test.csc.fi/geoserver/ogc/stac/api?f=application%2Fvnd.oai.openapi%2Bjson%3Bversion%3D3.0",
    "rel": "service-desc",
    "type": "application/vnd.oai.openapi+json;version=3.0",
    "title": "API definition for this endpoint as application/vnd.oai.openapi+json;version=3.0"
  }
],
  {
    "href": "https://paituli-test.csc.fi/geoserver/ogc/stac/api?f=application%2Fyaml",
    "rel": "alternate",
    "type": "application/x-yaml",
    "title": "This document as application/x-yaml"
  }
]
}

https://paituli-test.csc.fi/geoserver/ogc/stac/collections/sentinel_2_11_days_mosaics_at_fmi/items/Sentinel-2_global_mosaic_dekadi_2023-01-21_2023-01-31?f=application/json
// 20230428120931
// https://paituli-test.csc.fi/geoserver/ogc/stac/collections/sentinel_2_11_days_mosaics_at_fmi/items/Sentinel-2_global_mosaic_dekadi_2023-01-21_2023-01-31?f=application/json
{
  "id": "sentinel_2_11_days_mosaics_at_fmi",
  "title": "Sentinel-2 11-days surface reflectance mosaics.",
  "description": "Sentinel-2 11-days surface reflectance mosaics. Resolution: 10m. Data source: Sentinel-2 Global Mosaic Service. Mosaic postprocessing by SYKE.",
  "crs": [
    {
      "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
    }
  ],
  "stac_version": "1.0.0",
  "license": "CC-BY-4.0",
  "type": "Collection",
  "extent": {
    "spatial": {
      "bbox": [
        [
          15.053781,
          58.680079,
          36.021476,
          70.128835
        ]
      ]
    },
    "temporal": {
      "interval": [
        [
          "2017-02-01T00:00:00.000+00:00",
          "2023-01-31T23:59:59.000+00:00"
        ]
      ]
    }
  }
}

https://paituli-test.csc.fi/geoserver/ogc/stac/collections/sentinel_2_11_days_mosaics_at_fmi/items/Sentinel-2_global_mosaic_dekadi_2023-01-21_2023-01-31?f=application%2Fgeo%2Bjson
// 20230428121144
// https://paituli-test.csc.fi/geoserver/ogc/stac/collections/sentinel_2_11_days_mosaics_at_fmi/items/Sentinel-2_global_mosaic_dekadi_2023-01-21_2023-01-31?f=application%2Fgeo%2Bjson
{
  "stac_version": "1.0.0-rc2",
  "id": "Sentinel-2_global_mosaic_dekadi_2023-01-21_2023-01-31",
  "type": "Feature",
  "geometry": {
    "type": "Polygon",
    "coordinates": [
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          19.1165,
          58.6801
        ],
        [
          31.5898,
          58.84
        ],
        [
          33.9933,
          70.1288
        ],
        [
          15.0538,
          69.8629
        ],
        [
          19.1165,
          58.6801
        ]
      ]
    ]
  }
}
```

# STAC API

- Search API
- Fits big datasets
- Main focus on Item level
- Search criteria:
  - **Collection**
  - **Location:** point, bbox, GeoJSON polygon
  - **Time**
  - Optional other Item values, for example cloud coverage





# Tools for working with STAC

- Catalog search: [STAC Index](#)
- In web browser: [STAC Browser](#)
- QGIS: [STAC plugin](#)
- Python: [pystac-client](#), [stackstac](#), [xarray](#) and dask
- R: [rstac](#), [gdalcubes](#)
- PDAL: [STAC reader](#)
- ArcGIS for Python API
- Java, Julia, Ruby, Scala...



# CSC Paituli STAC, Finnish spatial datasets

- ESA, Sentinel-2 products, Level-2A
- ESA/FMI, Sentinel-1 daily and 11 days backscatter mosaics: VV and VH polarisation.
- ESA/FMI, Sentinel-2 11-days and annual surface reflectance mosaics.
- ESA/SYKE, Sentinel-2 monthly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI.
- ESA, Sentinel-1 backscatter tiles: VV and VH polarisation.
- USGS/SYKE, Landsat (4 and 5) yearly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI.
- NLS, Digital terrain model products: DTM, aspect, slope.
- Finnish Forest center, Canopy height model.
- LUKE, Multi-source forest inventory products.
- LUKE, Forest wind damage risk map.
- FMI, Daily wind damage risk map.

# CSC Paituli STAC, Finnish spatial datasets

## PLANS from GeoCubes



- Finnish Forest center, Forest stand class
- FMI, Wind
- GTK, Superficial deposits
- NLS, Peatland
- NLS, Building
- NLS, Orthophoto\*
- MAVI, Field parcels
- SYKE, Corine Land Cover
- SYKE, Vegetation height
- SYKE, Canopy cover

<sup>11</sup> \* These datasets have several bands in on file, Python stackstac does not support it, but search works.

# CSC Paituli STAC, Finnish spatial datasets

## PLANS from Paituli



- LUKE, erosion risk maps
- LUKE, cartographic wetness index
- LUKE, topographic wetness index
- LUKE, snow damage risk
- NLS, orthophoto and infrared orthophoto\*
- NLS, basic and topographic maps\*, 2005->
- FMI, historic weather in 10km grids\*: min/mean/max temperature, precipitation, snow, sea level air pressure, humidity, radiation\*, 1961->
  
- NLS, lidar ??

# CSC Paituli STAC

- Description: <https://paituli.csc.fi/stac.html>
- End-point: <https://paituli.csc.fi/geoserver/ogc/stac>
- [STAC Browser Paituli STAC:lle](#)
- Example scripts:
  - [Python](#)
  - [R](#)
- Feedback: [servicedesk@csc.fi](mailto:servicedesk@csc.fi)

Fairdata.fi  AVAA

The AVAA logo features a stylized globe with a green leaf-like element on the right side.

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# How to make own data available via STAC?

- Data:
  - Data in cloud-optimized format
  - Rasters: one band = one file
  - Each file must have URL or S3
- STAC
  - Static: create STAC JCON files
  - API: deploy a STAC server + add data to database
- Contact [giscoord@csc.fi](mailto:giscoord@csc.fi) if you want to add to Paituli STAC

## Behind the scenes

- GeoServer OpenSearch for EO community module
- PostGIS database
- rio-stac Python tool
  
- GeoPortti FIRI project
- Eetu Huusko, Kylli Ek

# Computing resources in Kajaani

- CSC Puhti supercomputer
  - Ready Python and R installations including STAC-libraries
  - For Finnish universities and research institutes
  - Free of charge for academic projects
- EuroHPC LUMI supercomputer
  - For EU: research + companies
- CPU and GPU in both



## Further links

- Paituli STAC: <https://paituli.csc.fi/stac.html>
- Geocomputing with supercomputers: <https://research.csc.fi/geocomputing>
- CSC EO tutorial: [https://docs.csc.fi/support/tutorials/gis/eo\\_guide/](https://docs.csc.fi/support/tutorials/gis/eo_guide/)
- Geocomputing in Puhti supercomputer course 12-13.10.2023: [https://ssl.eventilla.com/geocomputing\\_2023](https://ssl.eventilla.com/geocomputing_2023)

