



STAC - how to find and use spatiotemporal data easily?

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Non-profit state
organization with
special tasks



Turn over in 2023

73,6 M€



LUMI

Owned together with EuroHCP JU
and unique consortium of
10 countries – Belgium, Czech
Republic, Denmark, Estonia,
Finland, Iceland, Norway, Poland,
Sweden and Switzerland.



Headquarters
in Espoo,
data center
in Kajaani



Owned by the Finnish state (**70%**)
and all Finnish higher
education institutions (**30%**)



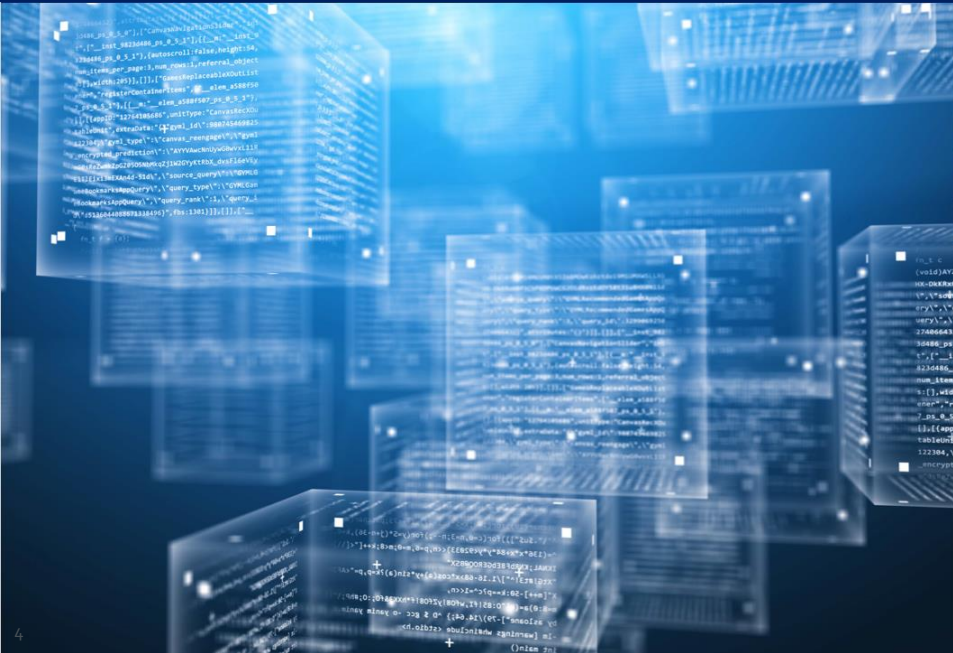
670
employees
(04.2024)

Computing services

- CPU + GPU + S3 storage
- CSC national services for Finnish academy
 - Puhti and Mahti supercomputers
 - Free of charge for research and teaching
 - 300+ geo-users
- LUMI, for EU academy + 20% for companies
 - LUMI supercomputer
 - **Deep learning**
- CSC helps each project to get started
- <https://research.csc.fi/geocomputing>



STAC intro

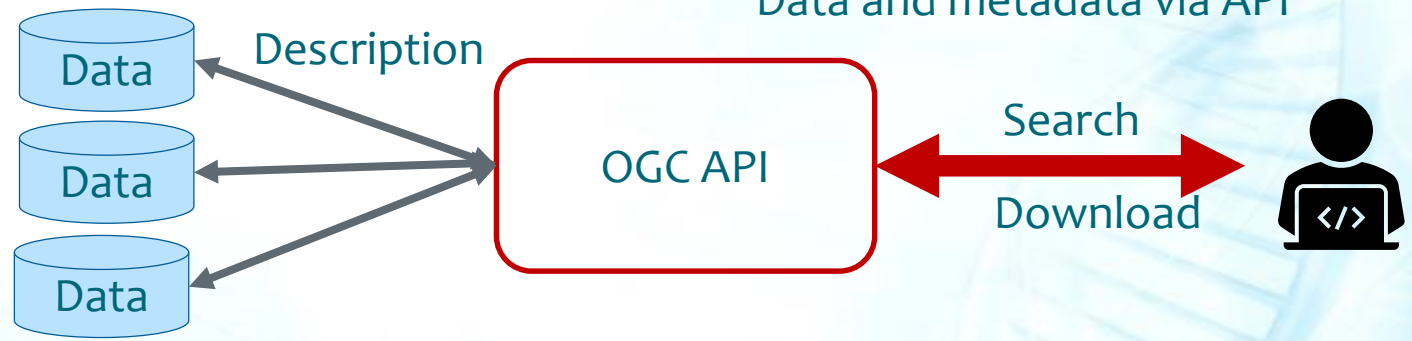


STAC - Spatio-Temporal Asset Catalog

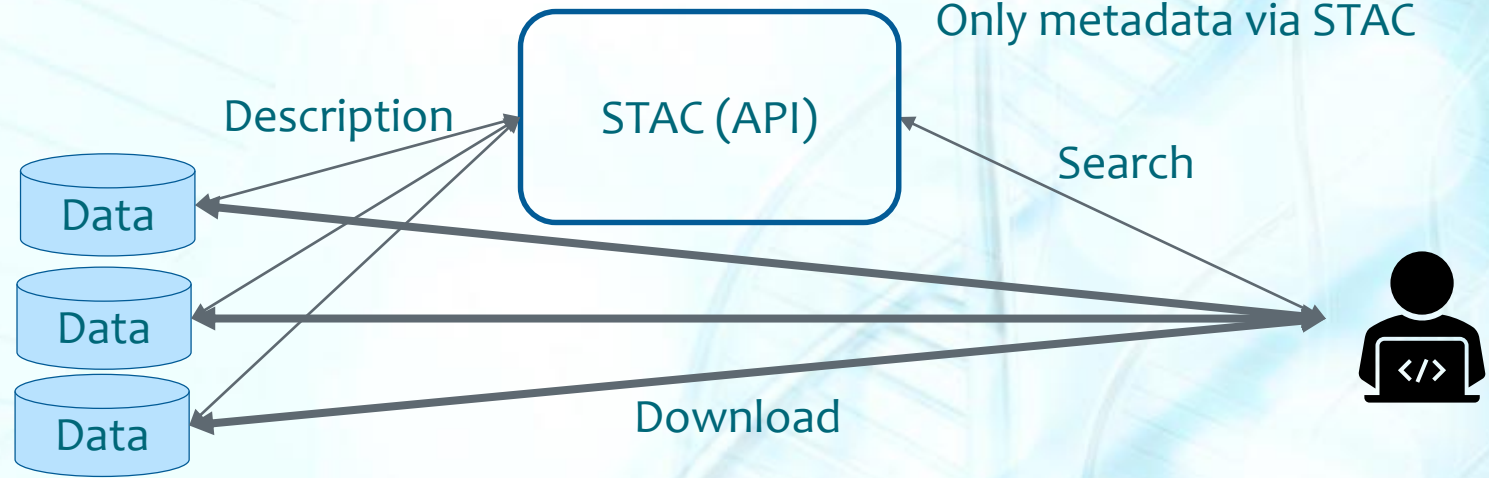
- Started in 2018, rapidly developing
- New de facto metadata and search standard
 - May become an OGC standard in the future.
- Describes datasets at the level of individual files.
- It is most commonly used for remote sensing data, but it is suitable for any data with **time** and **location** information.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



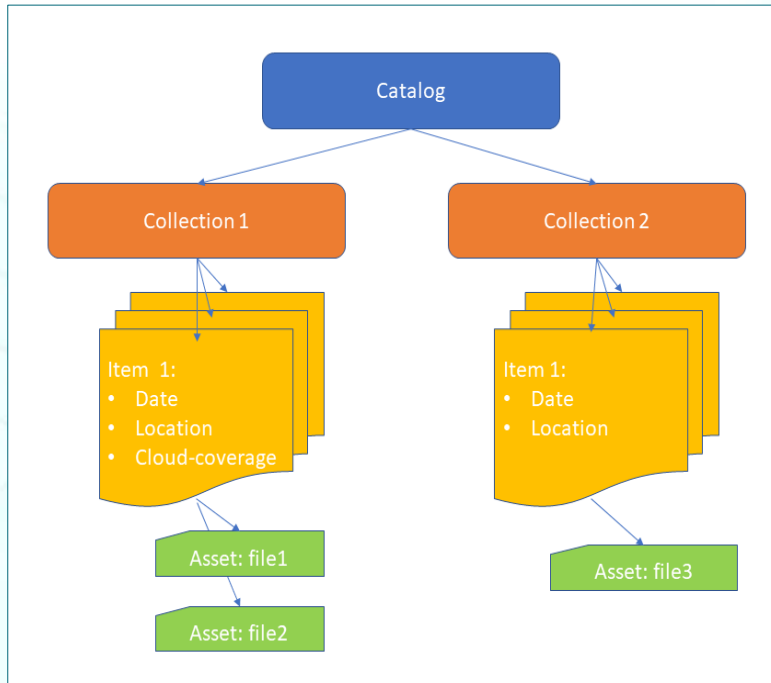
Data and metadata via API



Only metadata via STAC



STAC terminology



- Luettelo
- Kokoelma
- Tuote
- Resurssi

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"
    },
    {
      "href": "https://paituli-test.csc.fi/geoserver/ogc/stac/?f=text%2Fhtml",
      "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%2Fgeo%2Bjson
// 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": [
      [
        [
          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

Minimal Python code for using STAC API

```
import pystac-client
import stackstac
```

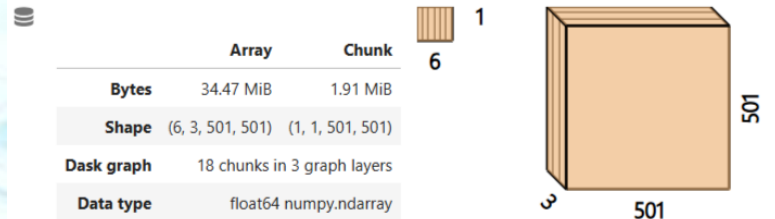
```
lon, lat = 24.945, 60.173, #Helsinki
```

```
catalog = pystac_client.Client.open('https://paituli.csc.fi/geoserver/ogc/stac/v1')
```

```
search = catalog.search(
    intersects=dict(type="Point", coordinates=[lon, lat]),
    collections=["sentinel_2_11_days_mosaics_at_fmfi"],
    datetime="2021-08-01/2021-09-30"
)
```

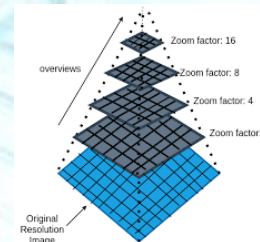
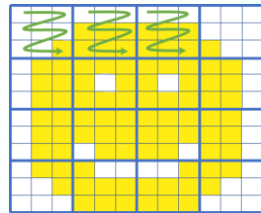
```
datacube = stackstac.stack(
    items=search.item_collection(),
    assets=["b04", "b03", "b02"]
).squeeze()
```

xarray.DataArray 'stackstac-25f35829c0aa0defefecdeb5932c2ccb' (time: 6, band: 3, y: 501, x: 501)



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: geoParquet ?




Paituli STAC



CSC Paituli STAC, Finnish spatial datasets

- ~ 175 raster datasets
- Stored at CSC, in Espoo datacenter:
 - [Paituli own data](#), only raster data, a lot of different datasets.
- Stored at CSC, in Kajaani datacenter:
 - ESA, [Sentinel-2 products](#), processed to Level-2A (Surface Reflectance), a selection of mostly cloud-free products from Finland. Downloaded to CSC Allas by Maria Yli-Heikkilä (LUKE), Arttu Kivimäki (NLS/FGI) and Matias Heino (Aalto).
 - [Geoportti geocubes](#) data, a lot of different raster datasets, all recalculated to common grid at several different resolutions.
- Stored at FMI, from [FMI Tuulituhohaukka static STAC catalog](#).

 sentinel

Sentinel-1 11-days backscatter mosaics: VV and VH polarisation.

Sentinel-1 11-days backscatter mosaics: VV and VH polarisation. Resolution: 20m. Covered area: Finland. Original Sentinel-1 data from ESA Copernicus Sentinel...

10/1/2014, 12:00:00 AM UTC - 3/21/2023, 11:59:59 PM UTC



Sentinel-2 11-days surface reflectance mosaics.

Sentinel-2 11-days surface reflectance mosaics. Resolution: 10m. Covered area: Finland. Original Sentinel-2 data from ESA Copernicus Sentinel Program, mosaic processing by...

2/1/2017, 12:00:00 AM UTC - 1/31/2023, 11:59:59 PM UTC



Sentinel-2 NIR (B08) 07/2021

Sentinel-2 satellite image mosaics produced from data provided by MultiSpectral Instruments (MSI) onboard Sentinel-2A and -2B satellites (B08)

1/1/2021, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

Sentinel-1 backscatter tiles: VV and VH polarisation.

Sentinel-1 backscatter tiles: VV and VH polarisation. Resolution: 20m. Covered area: Finland. Original Sentinel-1 data from ESA Copernicus Sentinel Program, processing ...

10/4/2014, 3:56:19 PM UTC - 3/23/2023, 4:31:08 PM UTC

Sentinel-2 annual surface reflectance mosaics.

Sentinel-2 annual surface reflectance mosaics. Resolution: 10m. Covered area: Finland. Original Sentinel-2 data from ESA Copernicus Sentinel Program, mosaic processing by...

1/1/2017, 12:00:00 AM UTC - 12/31/2021, 11:59:59 PM UTC

Sentinel-2 satellite image mosaic 07/2021

Sentinel-2 satellite image mosaics produced from data provided by MultiSpectral Instruments (MSI) onboard Sentinel-2A and -2B satellites (B02, B03, B04)

1/1/2021, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

Sentinel-2 L2A

Sentinel-2 products, processed to Level-2A (Surface Reflectance), a selection of mostly cloud-free products from Finland. More information: <https://a3s.fi/sentinel-...>

5/10/2016, 12:00:00 AM UTC - 10/29/2021, 12:00:00 AM UTC



Sentinel-2 SWIR (B11) 07/2021

Sentinel-2 satellite image mosaics produced from data provided by MultiSpectral Instruments (MSI) onboard Sentinel-2A and -2B satellites (B11)

1/1/2021, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

Sentinel-1 daily backscatter mosaics: VV and VH polarisation.

Sentinel-1 daily backscatter mosaics: VV and VH polarisation. Resolution: 20m. Covered area: Finland. Original Sentinel-1 data from ESA Copernicus Sentinel...

1/3/2017, 12:00:00 AM UTC - 3/30/2023, 12:00:00 AM UTC

Sentinel-2 monthly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI.

Sentinel-2 monthly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI. Resolution: 10m. Covered area: Finland. Available each year for April-October. Original Sentinel-2...

4/1/2016, 12:00:00 AM UTC - 10/31/2022, 11:59:59 PM UTC



- API definition for this endpoint as text/html

Sortables

- Sortables as application/schema+json
- Sortables as text/html

Catalogs **2/176**

Tiles List

Ascending Descending

landsat



Landsat (4 and 5) yearly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI (FMI Tuulituhohaukka)

Landsat (4 and 5) yearly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI. Scale: 30m. Available for the years 1984-2011. Landsat-4/5 imagery...

1984-01-01 00:00:00 UTC – 2011-12-31 23:59:59 UTC

Landsat, 30 m x 30 m (Paituli)

Landsat. Provided by NASA / USGS / Latuviitta. Scale: 30 m x 30 m. Coordinate systems: UTM 32-36.

2002-01-01 00:00:00 UTC – 2002-12-31 00:00:00 UTC

NLS, orthoimages

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Tiles

List

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ortho

Orthoimage, false colour newest, 1:10 000 (Paituli)

Orthoimage, false colour newest. Provided by National Land Survey of Finland. Scale: 1:10 000. Coordinate systems: ETRS-...

2010-01-01 00:00:00 UTC – 2024-12-31 00:00:00 UTC

Orthoimage, RGB or grayscale newest, 1:10 000 (Paituli)

Orthoimage, RGB or grayscale newest. Provided by National Land Survey of Finland. Scale: 1:10 000. Coordinate system...

2005-01-01 00:00:00 UTC – 2024-12-31 00:00:00 UTC

Orthophoto (GeoCubes)

Geometrically corrected aerial photograph. Provided by NLS. Scale: 1m-1000m. Coordinate system: ETRS-TM35FIN.

2018-01-01 00:00:00 UTC – 2022-12-31 00:00:00 UTC

Orthoimage, false colour, 1:10 000 (Paituli)

Orthoimage, false colour. Provided by National Land Survey of Finland. Scale: 1:10 000. Coordinate systems: KKJ, ETRS-...

1997-01-01 00:00:00 UTC – 2024-12-31 00:00:00 UTC

Orthoimage, RGB or grayscale, 1:10 000 (Paituli)

Orthoimage, RGB or grayscale. Provided by National Land Survey of Finland. Scale: 1:10 000. Coordinate systems: KKJ, ETRS-...

1996-01-01 00:00:00 UTC – 2024-12-31 00:00:00 UTC



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Tiles

List

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Descending

digi

Digital Surface Model (GeoCubes)

Surface model of both the natural and built/artificial features of the environment. Provided by NLS. Scale: 1m-1000m. Coordinate...

2008-01-01 00:00:00 UTC – 2022-12-31 00:00:00 UTC



Digital Terrain Model 2m, Aspect (GeoCubes)

Azimuth of the terrain surface's normal, DTM with 2m original resolution. Provided by NLS. Scale: 1m-1000m. Coordinate system: ETRS...

2022-01-01 00:00:00 UTC – 2022-12-31 00:00:00 UTC

Elevation model, 10 m x 10 m (Paituli)

Elevation model. Provided by National Land Survey of Finland. Scale: 10 m x 10 m. Coordinate systems: ETRS-TM35FIN.

2019-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC

Digital Terrain Model 10m (GeoCubes)

Digital Terrain Model (DTM) representing ground surface with 10m original resolution. Provided by NLS. Scale: 10m-1000m. Coordinate system:...

2018-01-01 00:00:00 UTC – 2018-12-31 00:00:00 UTC



Digital Terrain Model 2m, Slope (GeoCubes)

Angle between the terrain's tangent and horizontal plane, DTM with 2m original resolution. Provided by NLS. Scale: 1m-1000m....

2022-01-01 00:00:00 UTC – 2022-12-31 00:00:00 UTC

Elevation model, 2 m x 2 m (Paituli)

Elevation model. Provided by National Land Survey of Finland. Scale: 2 m x 2 m. Coordinate systems: ETRS-TM35FIN.

2019-02-08 12:47:57 UTC – 2025-01-05 01:03:50 UTC

Digital Terrain Model 2m (GeoCubes)

Digital Terrain Model (DTM) representing ground surface with 2m original resolution. Provided by NLS. Scale: 1m-1000m. Coordinate system: ETR...

2018-01-01 00:00:00 UTC – 2022-12-31 00:00:00 UTC



Digital terrain model products: DTM, aspect, slope (FMI Tuulituohoukka)

Digital terrain model products: DTM, aspect, slope. Scale: 2m. Coordinate system: ETRS-TM35FIN.

2020-01-01 00:00:00 UTC – 2020-12-31 23:59:59 UTC

Elevation model, 25 m x 25 m (Paituli)

Elevation model. Provided by National Land Survey of Finland. Scale: 25 m x 25 m. Coordinate systems: YKJ.

2000-01-01 00:00:00 UTC – 2000-12-31 00:00:00 UTC

FMI daily weather data

Catalogs 14/176 Files List Ascending Descending

daily

Daily global radiation, 10km, 10 km x 10 km (Paituli)

Daily global radiation, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily mean temperature, 10km, 10 km x 10 km (Paituli)

Daily mean temperature, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily precipitation sum, 10km, 10 km x 10 km (Paituli)

Daily precipitation sum, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily wind damage risk map (FMI Tuulituhohaukka)

Daily wind damage risk map. Scale: 500m. Coordinate system: ETRS-TM35FIN.

2010-01-01 00:00:00 UTC – 2023-09-20 00:00:00 UTC

Daily maximum temperature predictions, 10 km x 10 km (Paituli)

Daily maximum temperature predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: WGS84/ETRS-TM35FIN.

1981-01-01 00:00:00 UTC – 2100-12-31 00:00:00 UTC

Daily minimum temperature predictions, 10 km x 10 km (Paituli)

Daily minimum temperature predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: WGS84/ETRS-TM35FIN.

1981-01-01 00:00:00 UTC – 2100-12-31 00:00:00 UTC

Daily relative humidity, 10km, 10 km x 10 km (Paituli)

Daily relative humidity, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Sentinel-1 daily backscatter mosaics: VV and VH polarisation (FMI Tuulituhohaukka)

Sentinel-1 daily backscatter mosaics: VV and VH polarisation. Scale: 20m. Original Sentinel-1 data from ESA Copernicus Sentinel Program, processing by FMI. Coordinate system:...

2017-01-03 00:00:00 UTC – 2025-02-04 00:00:00 UTC

Daily maximum temperature, 10km, 10 km x 10 km (Paituli)

Daily maximum temperature, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily minimum temperature, 10km, 10 km x 10 km (Paituli)

Daily minimum temperature, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily sea level pressure, 10km, 10 km x 10 km (Paituli)

Daily sea level pressure, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Daily mean temperature predictions, 10 km x 10 km (Paituli)

Daily mean temperature predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: WGS84/ETRS-TM35FIN.

1981-01-01 00:00:00 UTC – 2100-12-31 00:00:00 UTC

Daily precipitation predictions, 10 km x 10 km (Paituli)

Daily precipitation predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: WGS84/ETRS-TM35FIN.

1981-01-01 00:00:00 UTC – 2100-12-31 00:00:00 UTC

Daily snow depth, 10km, 10 km x 10 km (Paituli)

Daily snow depth, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

FMI monthly weather data

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List

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month

Monthly average temperature, 1 km, 1 km x 1 km (Paituli)

Monthly average temperature, 1 km. Provided by Finnish Meteorological Institute. Scale: 1 km x 1 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2013-12-31 00:00:00 UTC

Monthly precipitation predictions, 10 km x 10 km (Paituli)

Monthly precipitation predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1975-01-01 00:00:00 UTC – 2085-12-31 00:00:00 UTC

Sentinel-2 monthly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI (FMI Tuulituhohaukka)

Sentinel-2 monthly index mosaics: NDVI, NDBI, NDMI, NDSI, NDTI. Scale: 10m. Available each year for April-October. Original Sentinel-2 data from ESA Copernicus...

2016-04-01 00:00:00 UTC – 2024-10-31 23:59:59 UTC

Monthly mean temperature predictions, 10 km x 10 km (Paituli)

Monthly mean temperature predictions. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1975-01-01 00:00:00 UTC – 2085-12-31 00:00:00 UTC

Monthly precipitation sum, 10km, 10 km x 10 km (Paituli)

Monthly precipitation sum, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Monthly mean temperature, 10km, 10 km x 10 km (Paituli)

Monthly mean temperature, 10km. Provided by Finnish Meteorological Institute. Scale: 10 km x 10 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2023-12-31 00:00:00 UTC

Monthly precipitation, 1 km, 1 km x 1 km (Paituli)

Monthly precipitation, 1 km. Provided by Finnish Meteorological Institute. Scale: 1 km x 1 km. Coordinate systems: ETRS-TM35FIN.

1961-01-01 00:00:00 UTC – 2013-12-31 00:00:00 UTC

Catalogs

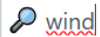
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Tiles

List

Ascending

Descending



wind



Daily wind damage risk map (FMI Tuulituhohaukka)

Daily wind damage risk map. Scale: 500m.
Coordinate system: ETRS-TM35FIN.

2010-01-01 00:00:00 UTC – 2023-09-20 00:00:00
UTC

Forest wind damage sensitivity map, 16 x 16 m (Paituli)

Forest wind damage sensitivity map.
Provided by Natural Resources Institute
Finland. Scale: 16 x 16 m. Coordinate...

2015-01-01 00:00:00 UTC – 2017-12-31 00:00:00
UTC

Wind speed 50 year return level, 20 m x 20 m (Paituli)

Wind speed 50 year return level. Provided
by Finnish Meteorological Institute. Scale:
20 m x 20 m. Coordinate systems: ETRS-...

1979-01-01 00:00:00 UTC – 2015-12-31 00:00:00
UTC

Forest wind damage risk map (FMI Tuulituhohaukka)

Forest storm damage risk map. Scale:
16m. Coordinate system: ETRS-TM35FIN.

2015-01-01 00:00:00 UTC – 2015-12-31 23:59:59
UTC

Wind speed 10 year return level, 20 m x 20 m (Paituli)

Wind speed 10 year return level. Provided
by Finnish Meteorological Institute. Scale:
20 m x 20 m. Coordinate systems: ETRS-...

1979-01-01 00:00:00 UTC – 2015-12-31 00:00:00
UTC

Wind velocity (GeoCubes)

Average wind velocity at the height of
50m. Provided by FMI. Scale: 2m-100m.
Coordinate system: ETRS-TM35FIN.

2007-01-01 00:00:00 UTC – 2007-12-31 00:00:00
UTC

LUKE/VMI, SYKE, Finnish Forest Center, canopy cover

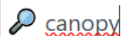
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Tiles

List

Ascending

Descending



canopy

Canopy cover (GeoCubes)

Percentage of the area covered by tree canopies. Provided by SYKE. Scale: 1m-1000m. Coordinate system: ETRS-TM35FIN.

2022-01-01 00:00:00 UTC – 2022-12-31 00:00:00
UTC

Canopy cover of broad-leaved trees (Paituli)

Canopy cover of broad-leaved trees. Provided by Natural Resources Institute Finland, forest inventory. Scale: 20 x 20 m,...

2006-01-01 00:00:00 UTC – 2021-12-31 00:00:00
UTC

Canopy height model (FMI Tuulituhohaukka)

Canopy height model. Scale: 1m. Coordinate system: ETRS-TM35FIN.

2019-01-01 00:00:00 UTC – 2019-12-31 23:59:59
UTC

Canopy cover (Paituli)

Canopy cover. Provided by Natural Resources Institute Finland, forest inventory. Scale: 20 x 20 m, 16 x 16 m. Coordinate...

2006-01-01 00:00:00 UTC – 2021-12-31 00:00:00
UTC

+ SYKE, vegetation height



<p>SPECTRE: 1_1 Mining density, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_1 Mining density. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2020-01-01 00:00:00 UTC – 2020-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_3 Population density, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_3 Population density. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2015-01-01 00:00:00 UTC – 2015-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_9 Anthropogenic biomes, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_9 Anthropogenic biomes. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2001-01-01 00:00:00 UTC – 2006-12-31 00:00:00 UTC</p>	<p>SPECTRE: 5_2 Temperature trend significance, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 5_2 Temperature trend significance. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1990-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC</p>
<p>SPECTRE: 1_10 Mean fire occurrence, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_10 Mean fire occurrence. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2006-01-01 00:00:00 UTC – 2016-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_4 Proportion of built-up area, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_4 Proportion of built-up area. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2014-01-01 00:00:00 UTC – 2014-12-31 00:00:00 UTC</p>	<p>SPECTRE: 2_1 Forest tree cover loss between 2007 and 2017, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 2_1 Forest tree cover loss between 2007 and 2017. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems:...</p> <p>2007-01-01 00:00:00 UTC – 2017-12-31 00:00:00 UTC</p>	<p>SPECTRE: 5_3 Trend of climate extremes, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 5_3 Trend of climate extremes. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1990-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC</p>
<p>SPECTRE: 1_11 Proportion of cropland (UNI), 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_11 Proportion of cropland (UNI). Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1999-01-01 00:00:00 UTC – 2014-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_5 Road density, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_5 Road density. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1997-01-01 00:00:00 UTC – 2015-12-31 00:00:00 UTC</p>	<p>SPECTRE: 2_2 Forest loss trend, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 2_2 Forest loss trend. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2001-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC</p>	<p>SPECTRE: 5_4 Velocity of climate change, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 5_4 Velocity of climate change. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2000-01-01 00:00:00 UTC – 2020-12-31 00:00:00 UTC</p>
<p>SPECTRE: 1_12 Proportion of cropland (IASA), 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_12 Proportion of cropland (IASA). Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2005-01-01 00:00:00 UTC – 2005-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_6 Human footprint, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_6 Human footprint. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1995-01-01 00:00:00 UTC – 2004-12-31 00:00:00 UTC</p>	<p>SPECTRE: 3_1 Light pollution, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 3_1 Light pollution. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2015-01-01 00:00:00 UTC – 2015-12-31 00:00:00 UTC</p>	<p>SPECTRE: 5_5 Aridity trends, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 5_5 Aridity trends. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1990-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC</p>
<p>SPECTRE: 1_13 Livestock wet biomass, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_13 Livestock wet biomass. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2005-01-01 00:00:00 UTC – 2005-12-31 00:00:00 UTC</p>	<p>SPECTRE: 1_7 Human impact, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 1_7 Human impact. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>2000-01-01 00:00:00 UTC – 2018-12-31 00:00:00 UTC</p>	<p>SPECTRE: 5_1 Temperature trends, 1 km x 1 km (Paituli)</p> <p>SPECTRE: 5_1 Temperature trends. Provided by University of Helsinki, Luomus. Scale: 1 km x 1 km. Coordinate systems: WGS-84.</p> <p>1990-01-01 00:00:00 UTC – 2019-12-31 00:00:00 UTC</p>	

.. and more

- NLS, buildings
- NLS, administrative units
- NLS, sea regions
- MAVI, land parcels
- SYKE, CORINE land cover 
- GTK, peatland
- GTK, superficial deposits 

NLS historic maps

	Years	Scales
Russian topographic maps	1870-1944	1:21 000 – 1 :84 000
Parish maps	1912-1968	1:20 000
Topographic maps	1922-2020	1:20 000 – 1:100 000
General maps	1863-2020	1:400 000 – 1:500 000
Economic maps	1911-1970	1:100 000

CSC Paituli STAC

- Description: <https://paituli.csc.fi/stac.html>
- End-point: <https://paituli.csc.fi/geoserver/ogc/stac/v1>
- [STAC Browser Paituli STAC:lle](#)
- Example scripts:
 - [Python](#),
 - Also for FMI STAC and Element84 Sentinel2 COGs STAC
 - [R](#)
- Feedback: servicedesk@csc.fi

Fairdata.fi  AVAA

geo
portti | Finnish Geospatial
Research and
Education Hub

Citing

1. Most datasets available with CC-4.0.BY license, mention data producers according to that
2. Please mention also usage of Paituli STAC and GeoPortti

We made use of geospatial data/instructions provided by Geoportti RI (Open Geospatial Information Infrastructure for Research, urn:nbn:fi:research-infras-2016072513) and Paituli STAC.

Tools for working with STAC



Tools for working with STAC

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



FOSS4G used for STAC end-users

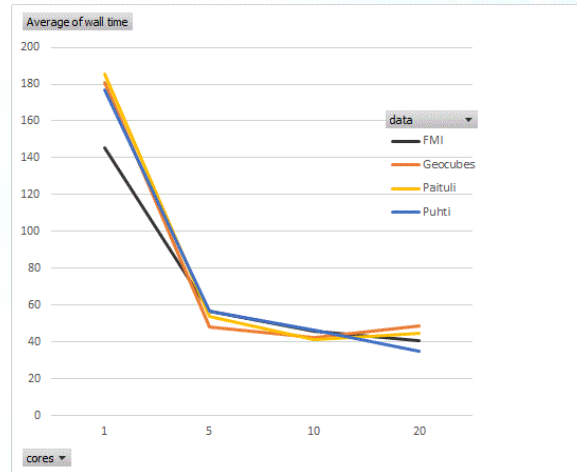
- End-user tools according to statistics:

Python	50145
R	7262
FME	6344
GDAL	1736
radianteearth.github.io	1670
stacindex.org	1264
paituli.csc.fi	992

Scaling

2-3 weeks at CSC

- Current problem: parallelizing to more than 5-10 cores does not give any benefit
 - Likely limited by IO, but also from local parallel disk?



Other STAC catalogs

- Element 84, [Earth Search STAC](#) (Sentinel 2 and 1, Landsat, Copernicus DEM)
- ESA <https://documentation.dataspace.copernicus.eu/APIs/STAC.html>
- [EDITO STAC](#) (Digital twin of ocean)
- [Destination Earth STAC](#)
- Aalto, [Climate risk STAC](#)
- FMI, [Tuulituhohaukka STAC](#) (harvested to Paituli STAC)
- More in [STAC Browser](#) and [STAC index](#)