

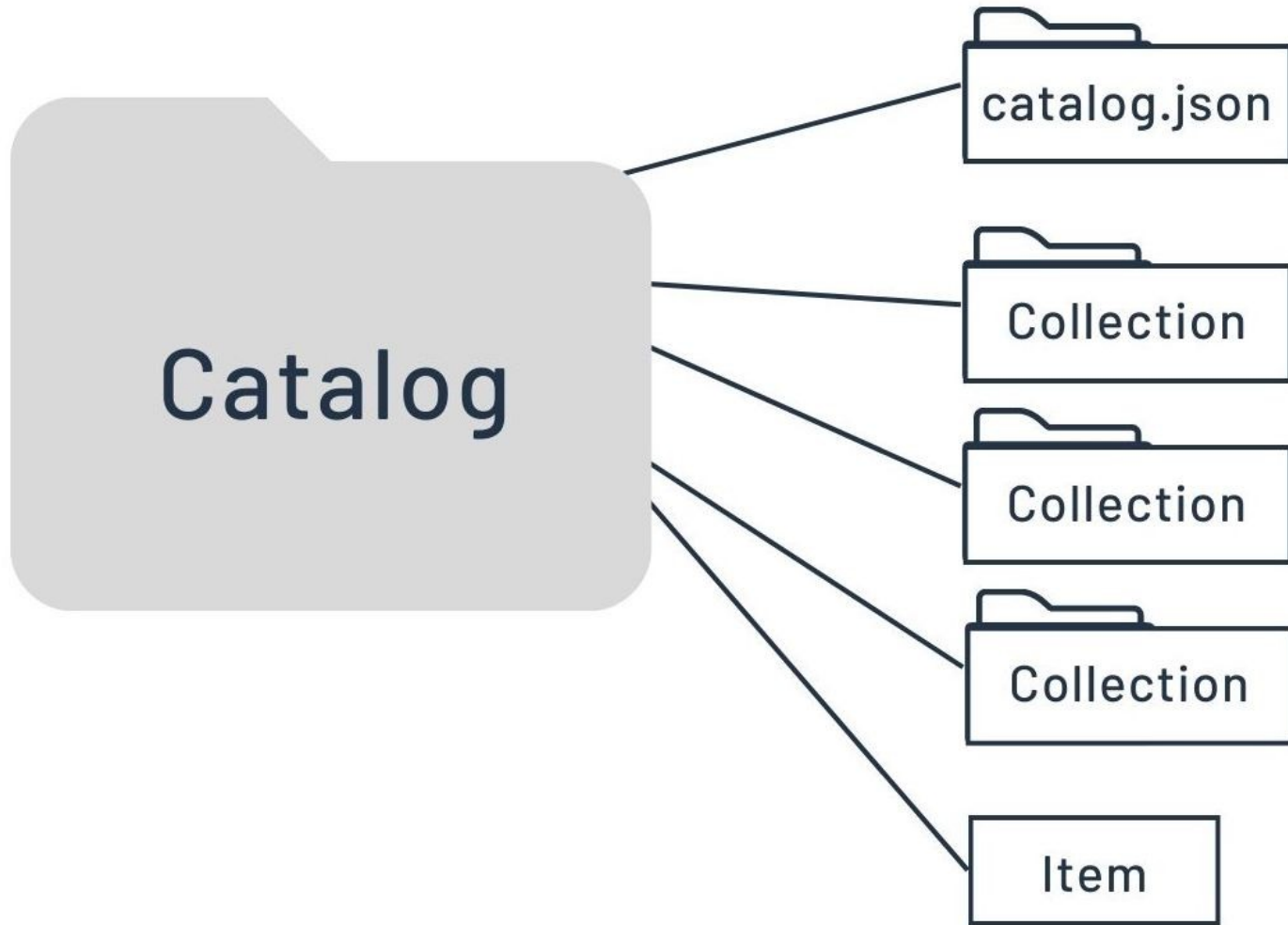
django



What is STAC?

STAC SpatioTemporal Asset Catalog

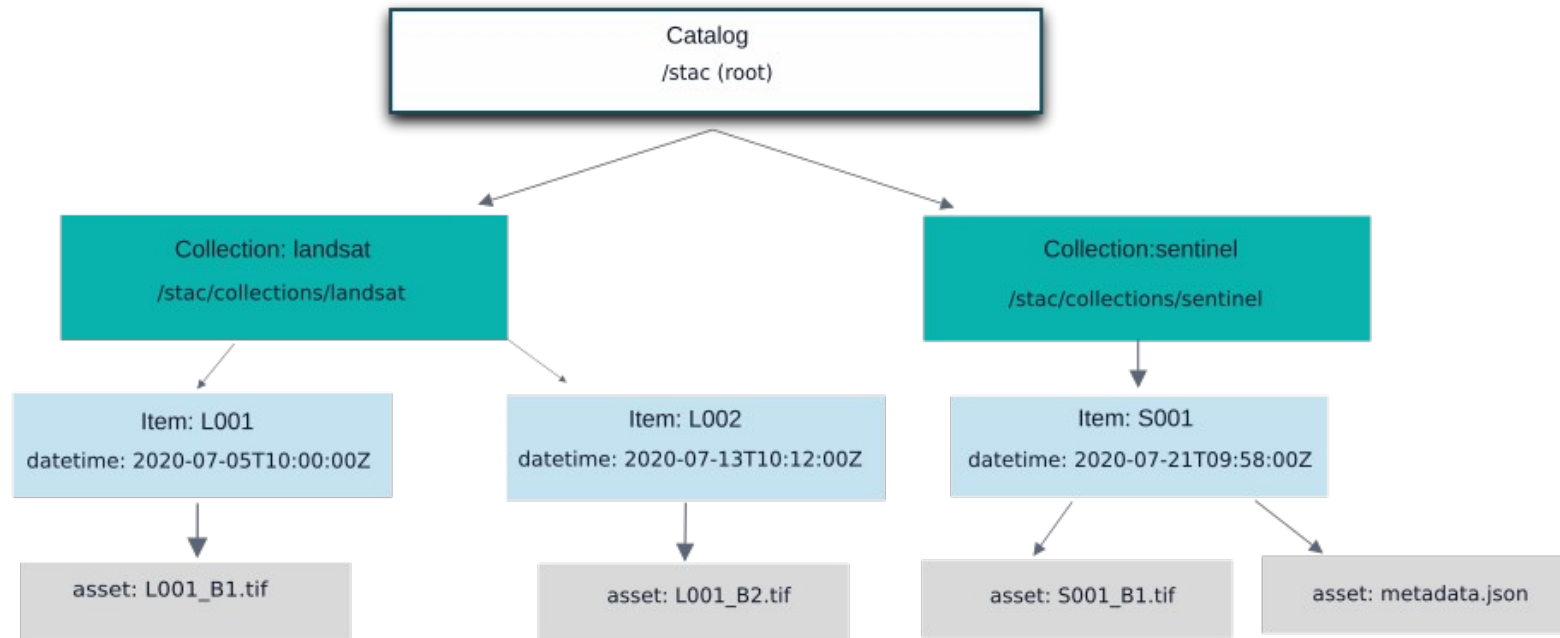
STAC Components



STAC Catalogs

Static Catalog

```
{
  "type": "Catalog",
  "id": "example-catalog",
  "stac_version": "1.1.0",
  "description": "STAC basic demonstration",
  "links": [
    {
      "rel": "root",
      "href": "./catalog.json",
      "type": "application/json"
    },
    {
      "rel": "child",
      "href": "./collection/collection.json",
      "type": "application/json",
      "title": "Collection with items (standalone)"
    },
    {
      "rel": "item",
      "href": "./item/item.json",
      "type": "application/json"
    }
  ]
}
```

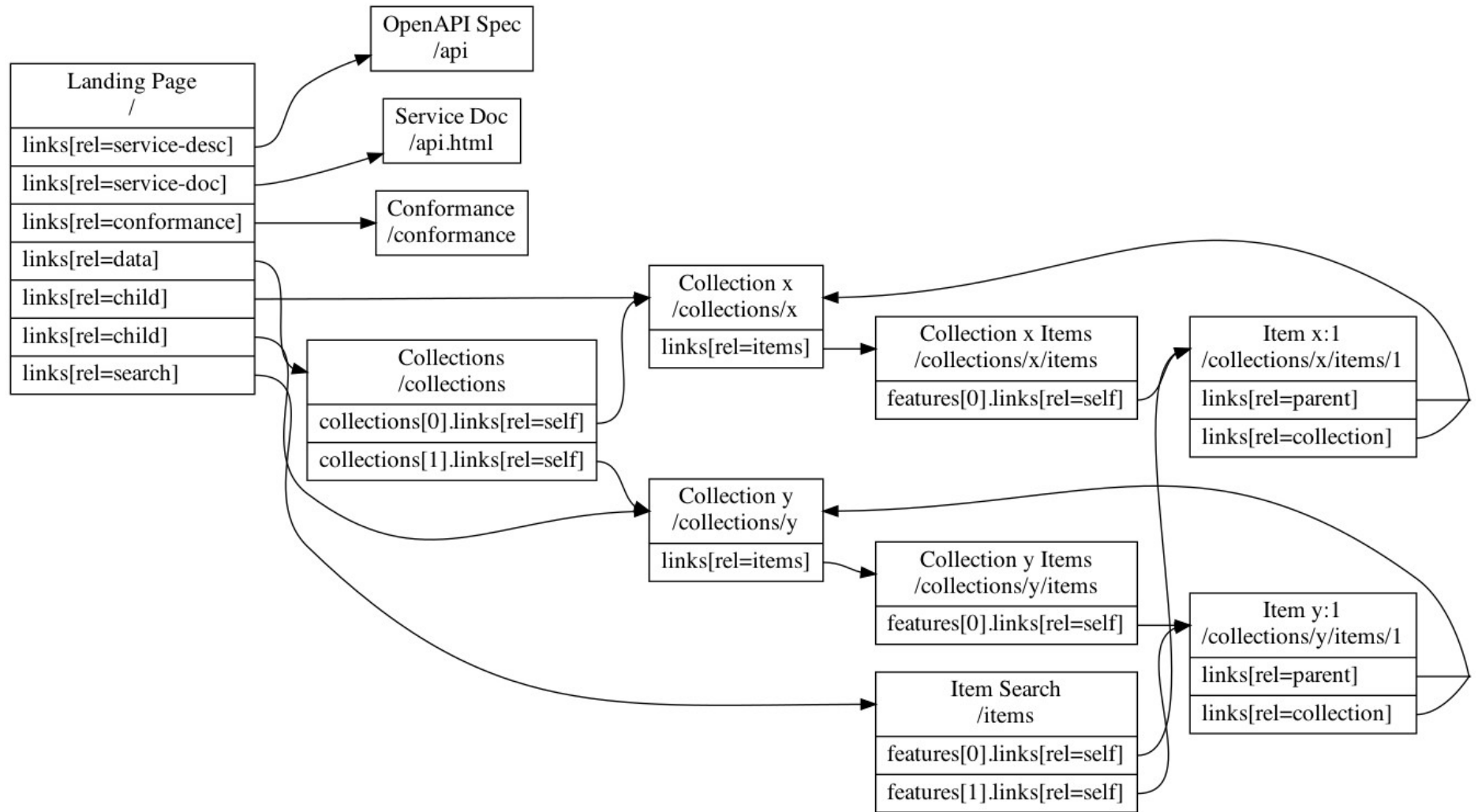


Legend

- Collection
- Item
- Asset (file)

STAC structure: Catalog → Collections → Items → Assets (files)

STAC API Links

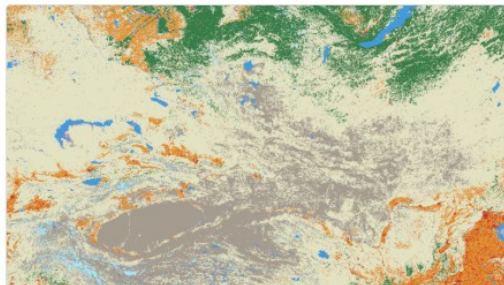


STAC Assets

```
[{
  "href": "/assets/LC08_L2SP_047027_20200729_02_T1_SR_B4.tif",
  "title": "Asset data",
  "type": "image/tiff; application=geotiff",
  "roles": [
    "data"
  ]
},

{
  "href":
"/assets/LC08_L2SP_047027_20200729_02_T1_SR_B4/thumbnail.png",
  "title": "Asset thumbnail",
  "type": "image/png",
  "roles": [
    "thumbnail"
  ]
}]
```

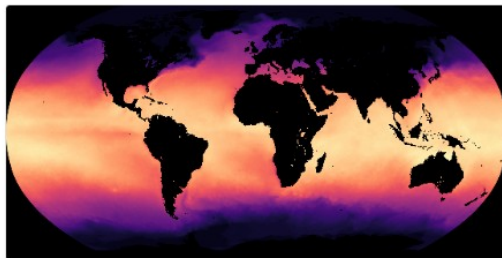
MICROSOFT PLANETARY COMPUTER STAC API



10m Annual Land Use Land Cover (9-class)
V1

COG Note: A new version of this item is available for your use. This mature version of the map remains available for use in existing applications. This item wil...

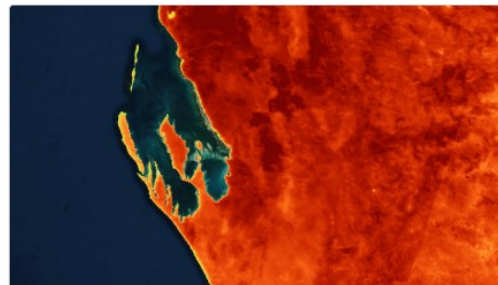
2017-01-01 00:00:00 UTC – 2023-01-01 00:00:00 UTC



ERA5 - PDS

Zarr ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate covering the period from January 1950 to present. ERA5 is produced by...

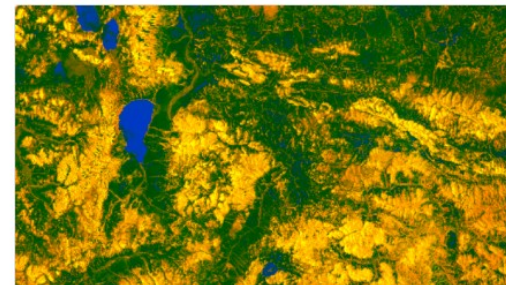
1979-01-01 0:00:00 UTC until present



MODIS Land Surface Temperature/Emissivity
8-Day

HDF **COG** The Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature/Emissivity 8-Day Version 6.1 product...

2000-02-18 0:00:00 UTC until present



Sentinel 1 Radiometrically Terrain Corrected
(RTC)

COG The Sentinel-1 mission is a constellation of two polar-orbiting satellites, operating day and night performing C-band synthetic aperture radar imaging...

2014-10-10 0:28:21 UTC until present



10m Annual Land Use Land Cover (9-class)
V2

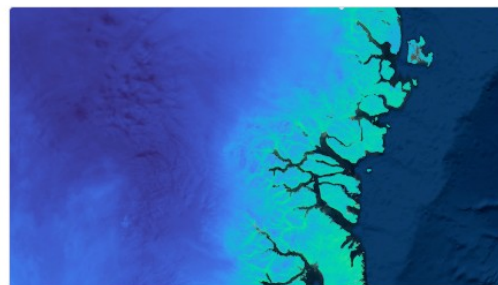
COG Time series of annual global maps of land use and land cover (LULC). It currently has data from 2017-



ESA Climate Change Initiative Land Cover
Maps (Cloud Optimized GeoTIFF)

COG The ESA Climate Change Initiative (CCI) Land Cover dataset provides consistent global annual land cover maps at 300m spatial resolution from 1992 to...

1992-01-01 00:00:00 UTC – 2020-12-31 23:59:59 UTC



MODIS Land Surface Temperature/Emissivity
Daily

HDF **COG** The Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature/Emissivity Daily Version 6.1 product...



Sentinel-2 Level-2A

COG The Sentinel-2 program provides global imagery in thirteen spectral bands at 10m-60m resolution and a revisit time of approximately five days. This dataset...

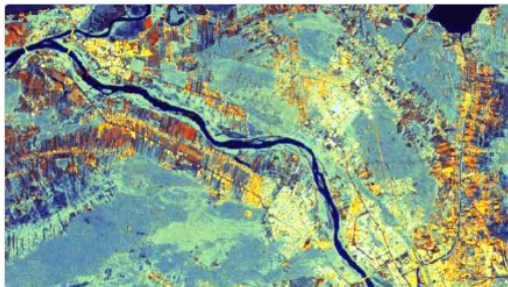
2015-06-27 10:25:31 UTC until present

COPERNICUS DATA SPACE ECOSYSTEM STAC CATALOG

Cubes and Clouds - Snow Cover

COG Snow Cover Community Mapping Project of the MOOC Cubes and Clouds - Cloud Native Open Data Science for Earth Observation. Every item comes from...

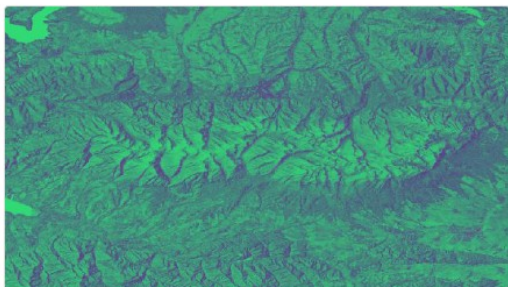
2017-12-01 00:00:00 UTC – 2025-03-20 00:00:00 UTC



Sentinel-1 Global Mosaics

COG **ZIP** Sentinel-1 monthly mosaics are generated from monthly stacks of Sentinel-1 GRD data by calculating the weighted sum of the terrain corrected...

2020-01-01 0:00:00 UTC until present



Sentinel-1 Ground Range Detected (GRD)



Sentinel-3 SRAL Land Radar Altimetry - Sea Ice (NRT)

ZIP **NetCDF** This Collection provides Sentinel-3 SRAL Level-2 Land Altimetry Sea Ice products, which contains estimations of the radar freeboard over the...

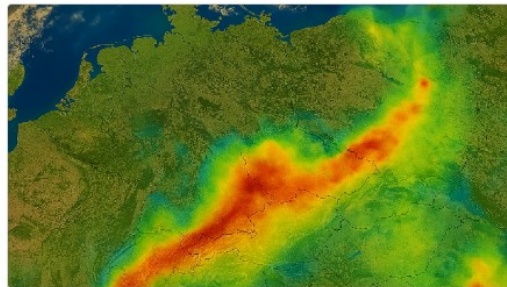
2023-09-20 5:44:46 UTC until present



Sentinel-3 SRAL Land Radar Altimetry - Sea Ice (NTC)

ZIP **NetCDF** This Collection provides Sentinel-3 SRAL Level-2 Land Altimetry Sea Ice products, which contains estimations of the radar freeboard over the...

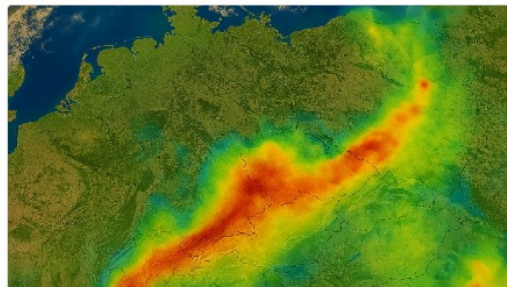
2016-03-01 14:07:51 UTC until present



Sentinel-5P Level 1 Radiance Band 3 (OFFL)

NetCDF This Collection provides Sentinel-5P Level-1 RA BD3 products, which contains Earth radiance spectra for spectral band 3.

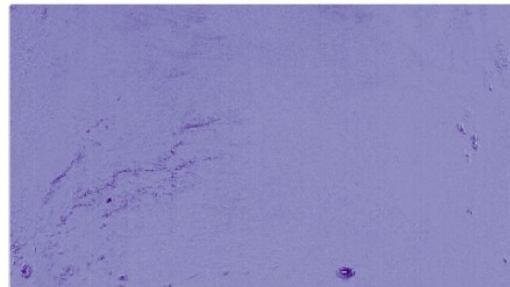
2018-04-30 0:19:50 UTC until present



Sentinel-5P Level 1 Radiance Band 3 (RPRO)

NetCDF This Collection provides Sentinel-5P Level-1 RA BD3 products, which contains Earth radiance spectra for spectral band 3.

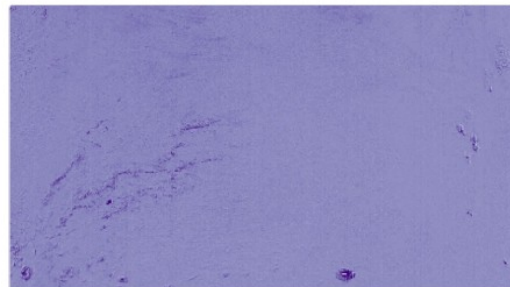
2018-04-30 0:19:50 UTC until present



Sentinel-5P Level 2 Formaldehyde (OFFL)

NetCDF This Collection provides Sentinel-5P Level-2 HCHO products, which contains high-resolution imagery of atmospheric formaldehyde concentrations.

2018-04-30 0:18:51 UTC until present



Sentinel-5P Level 2 Formaldehyde (RPRO)

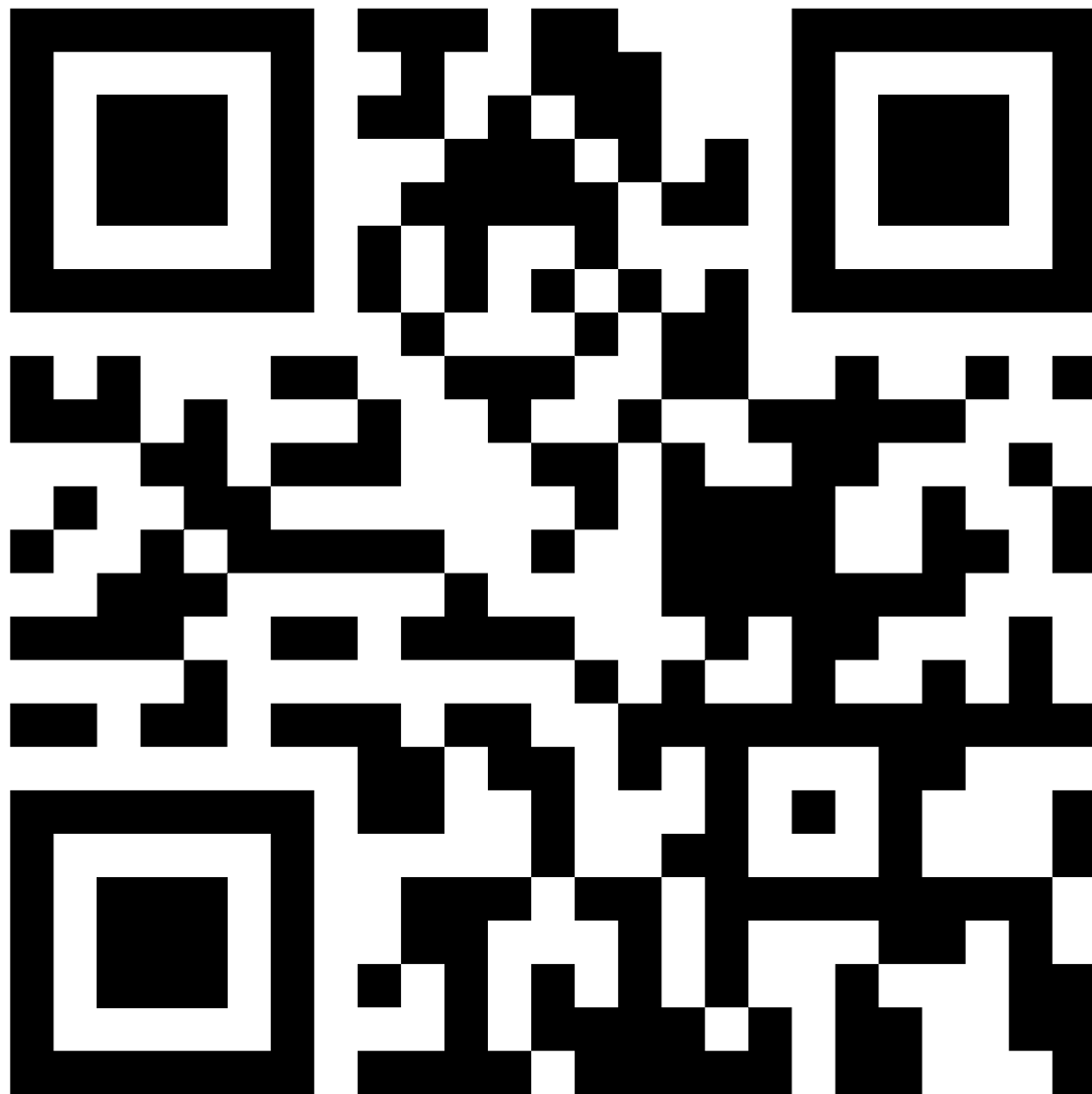
NetCDF This Collection provides Sentinel-5P Level-2 HCHO products, which contains high-resolution imagery of atmospheric formaldehyde concentrations.

2018-04-30 0:18:51 UTC until present



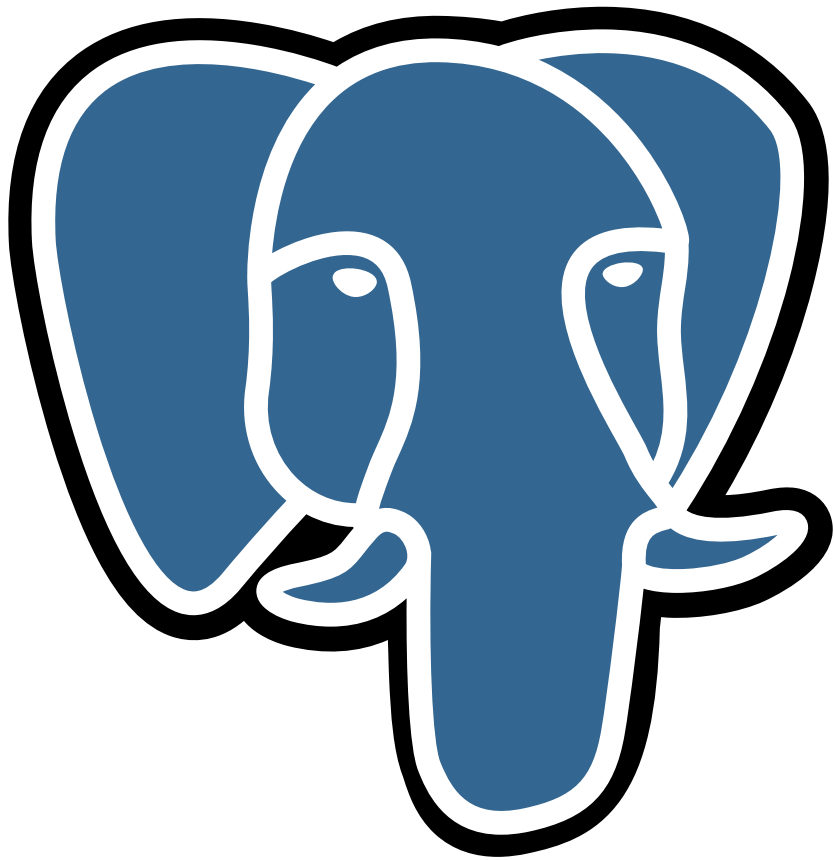
See more STAC
catalogs

<https://stacindex.org/catalogs>



Building STAC APIs

- PostGIS
- GeoDjango
- Django Rest Framework
- Validators(stac and stac-api)



PostGIS

PostGIS

- Rich in geospatial functions (1000 functions!)
- Spatial Indexing and Filtering
- Django Integration

Spatial Indexing

```
from django.contrib.gis.geos import Polygon

bbox = Polygon.from_bbox((-10, -10, 10, 10))
items = STACItem.objects.filter(geometry__intersects=bbox)
```

```
Index Scan using stac_items_geom_idx on stac_items
(cost=0.14..12.43 rows=50 width=...)
  Index Cond: (geometry && '0103000020E6100000... '::geometry)
  Filter: _st_intersects(geometry,
'0103000020E6100000... '::geometry)
```

Planning Time: **0.089 ms**
Execution Time: **1.21 ms**

GeoDjango



```
from django.contrib.gis.db import models
```

- Modeling
- Spatial queries
- GeoJSON serialization

GeoDjango

```
from django.contrib.gis.db import models

class STACCollection(models.Model):
    spatial_extent = models.PolygonField(srid=4326)
    ...other fields

class STACItem(models.Model):
    geometry = models.GeometryField(srid=4326)
    ...other fields
```

GeoDjango

```
from django.contrib.gis.geos import Polygon
from rest_framework.response import Response
from rest_framework import viewsets
from .models import STACItem
from .serializers import STACItemSerializer

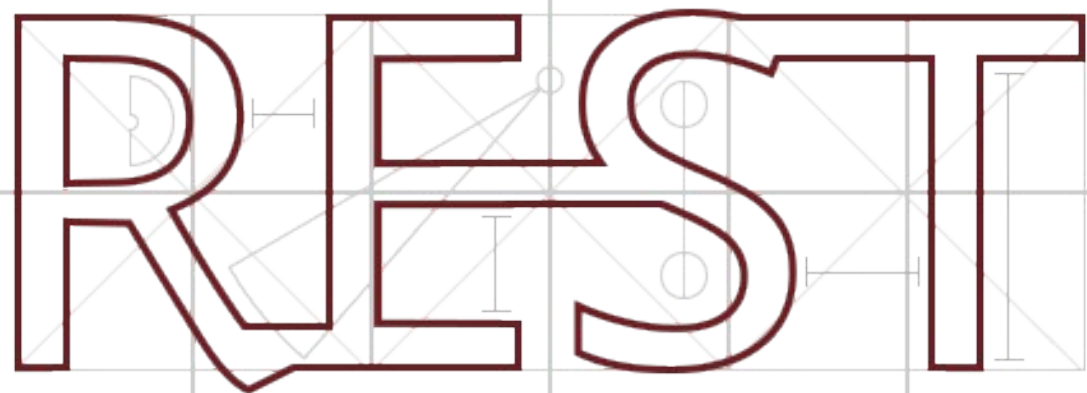
class STACItemViewSet(viewsets.ReadOnlyModelViewSet):
    queryset = STACItem.objects.all()
    serializer_class = STACItemSerializer

    def list(self, request, *args, **kwargs):
        bbox = request.query_params.get('bbox')
        if bbox:
            minx, miny, maxx, maxy = map(float, bbox.split(','))
            bbox_poly = Polygon.from_bbox((minx, miny, maxx, maxy))
            self.queryset =
self.queryset.filter(geometry__intersects=bbox_poly)

        return super().list(request, *args, **kwargs)

/stac/api/search?bbox=-36.5,-3.6,37.0,-3.2
```

django

The word "REST" is rendered in a large, dark red, outlined serif font. It is centered over a light gray grid that includes both horizontal and vertical lines, as well as diagonal lines forming an X pattern. Several small, faint technical drawing elements are visible on the grid, including circles and dimension lines with arrows, suggesting a blueprint or architectural theme.

framework

DRF

- Structure(API endpoints)
- CRUD Endpoints
- Browsable

Django Rest Framework

```
/stac/  
/stac/collections  
/stac/collections/{collection_id}  
/stac/collections/{collection_id}/items
```

```
class STACCollectionViewSet(viewsets.ReadOnlyModelViewSet):  
    queryset = STACCollection.objects.all()  
    serializer_class = STACCollectionSerializer  
    lookup_field = 'collection_id'
```

```
from rest_framework_gis.serializers import GeoFeatureModelSerializer  
  
class STACAssetSerializer(GeoFeatureModelSerializer):  
    class Meta:  
        model = STACAsset  
        fields = [  
            'href', 'title', 'type', 'roles', 'asset_file', 'thumbnail'  
        ]
```

STAC Validation

- stac-validator
- stac-api-validator

Large Datasets & Performance

- Cloud Storage(S3, minio, Google Cloud Storage)
- Indexing

```
from django.contrib.gis.db import models
```

```
class STACItem(models.Model):  
    geometry = models.GeometryField(srid=4326, spatial_index=True)  
    datetime = models.DateTimeField(db_index=True)
```

Django built STAC API inside
STAC Browser.

Don'ts



- Skip STAC Documentation!
- Store geometry using other types
- Unpaginate large items and collections

Benefits

- Common web standards
- Easy to extend
- Ecosystem

Lets have a django-stac package?

Asanteni!