

# Django, GeoDjango and STAC

Samweli Mwakisambwe

Dar es salaam, Tanzania



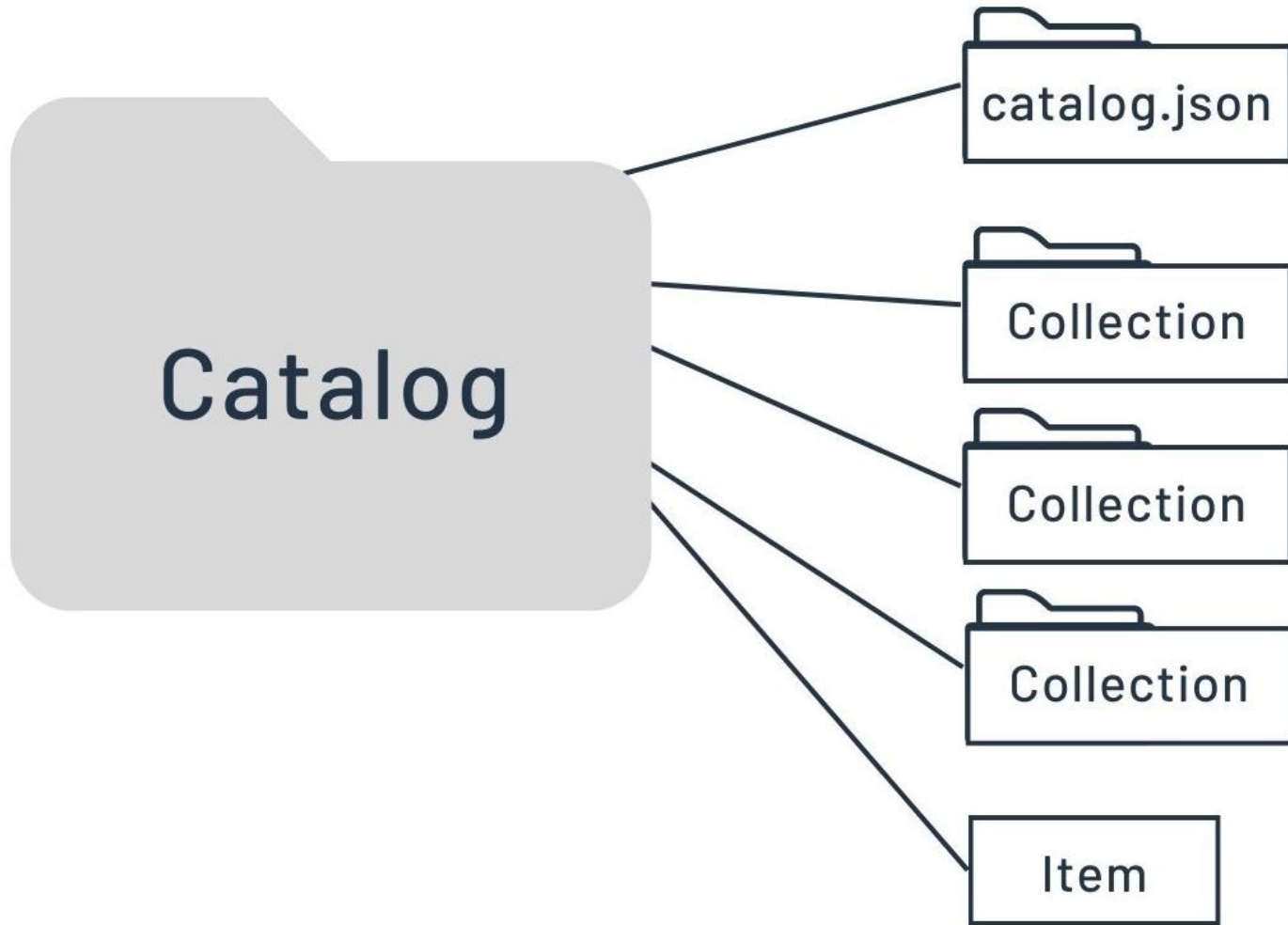
**django**



What is STAC?

# STAC SpatioTemporal Asset Catalog

# STAC Components

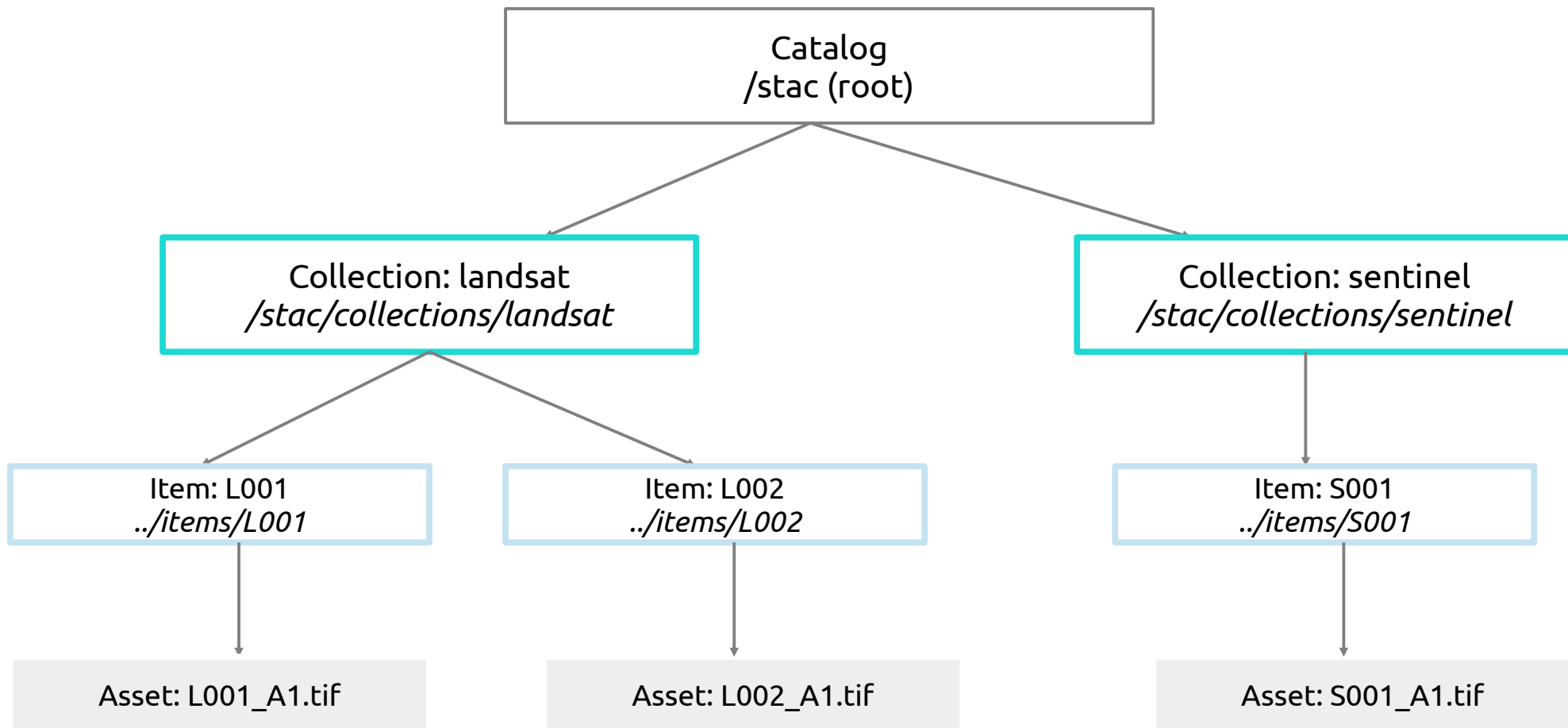


# STAC Catalogs

# 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"
    }
  ]
}
```



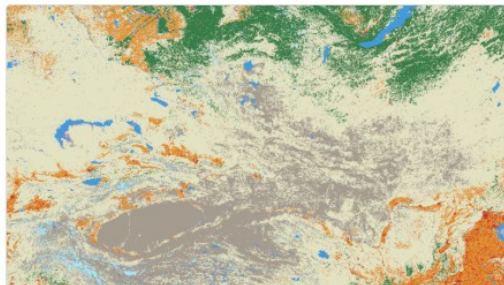


# STAC Assets

```
[{
  "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"
  ]
}]
```

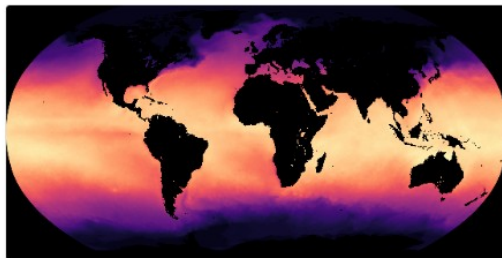
# MICROSOFT PLANETARY COMPUTER STAC CATALOG



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...

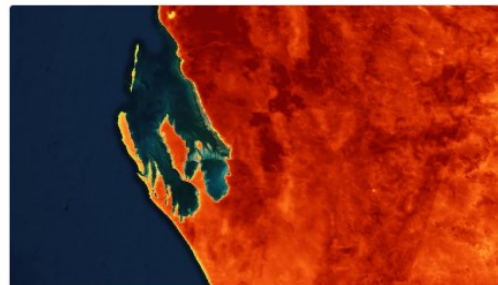
2017-01-01 00:00:00 UTC – 2023-01-01 00:00:00 UTC



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...

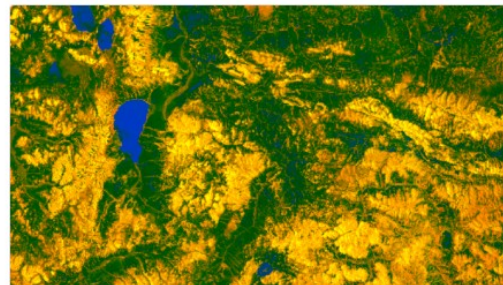
1979-01-01 0:00:00 UTC until present



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

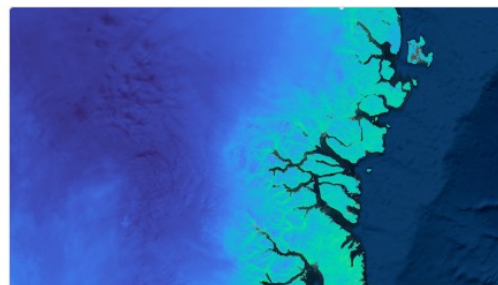
**COG** Time series of annual global maps of land use and land cover (LULC). It currently has data from 2017-



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

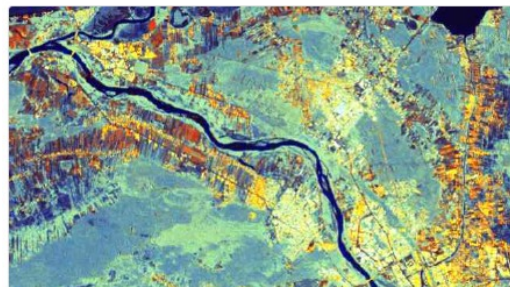


# EUROPEAN DATA SPACE ECOSYSTEM STAC CATALOG

## 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...

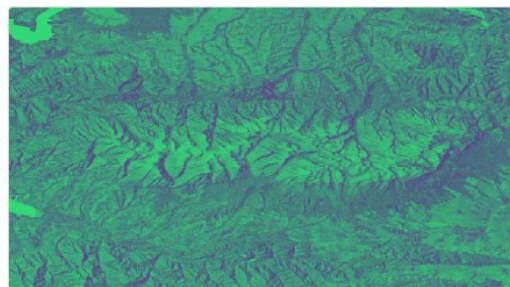
2017-12-01 00:00:00 UTC – 2025-03-20 00:00:00 UTC



## 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



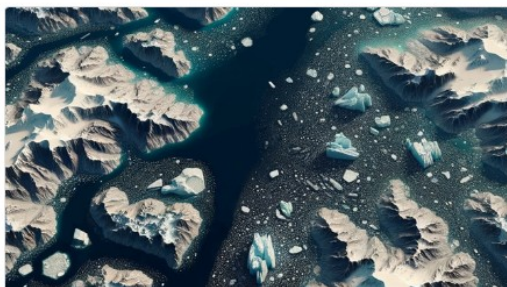
## Sentinel-1 Ground Range Detected (GRD)



## 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...

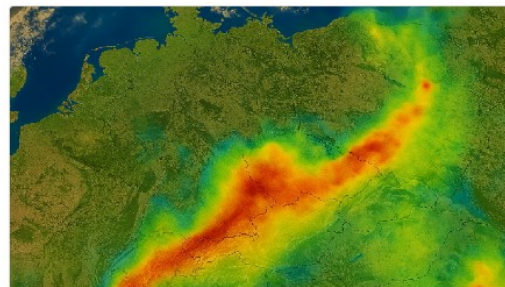
2016-03-01 14:07:51 UTC until present



## 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.

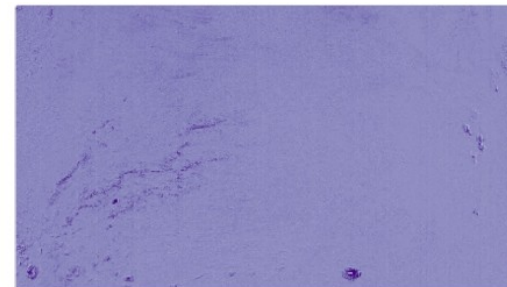
2018-04-30 0:19:50 UTC until present



## 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.

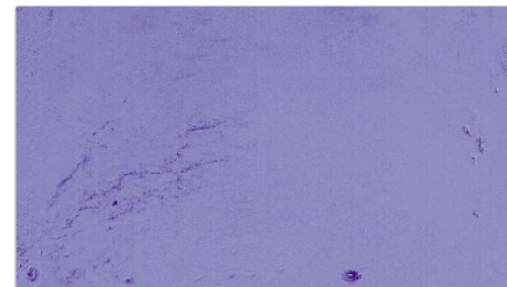
2018-04-30 0:19:50 UTC until present



## 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)

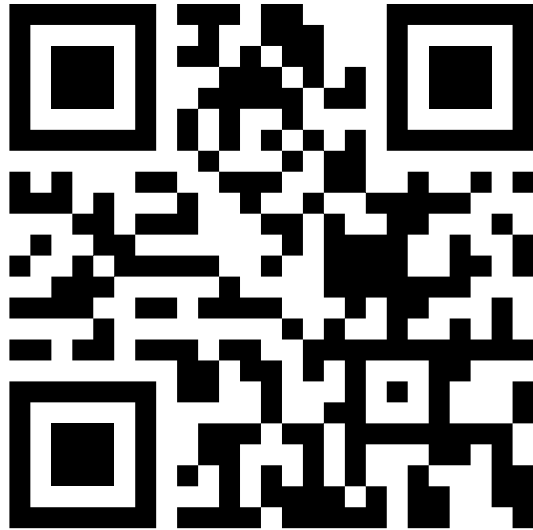
**NetCDF** This Collection provides Sentinel-5P Level-2 HCHO products, which contains high-resolution imagery of atmospheric formaldehyde concentrations.

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



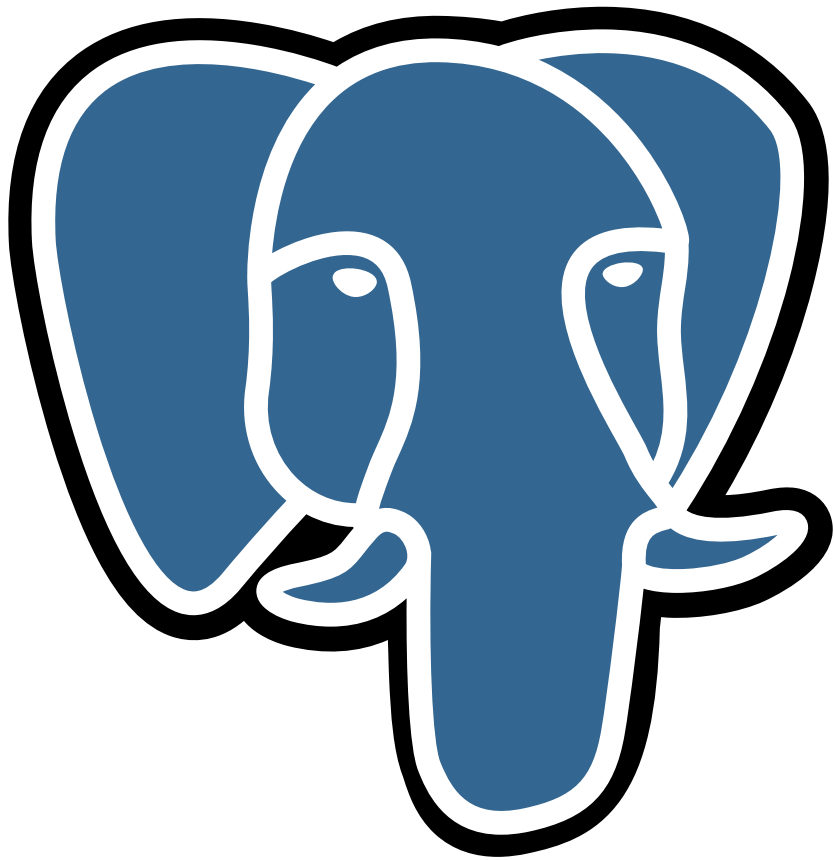
# See more STAC catalogs

<https://stacindex.org/catalogs>



# Building STAC Catalogs

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



PostGIS



# PostGIS

- Rich in geometry 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 support

# 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
```

# Django Rest Framework

- API structure
- 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  
from .models import STACItem
```

```
class STACItemSerializer(GeoFeatureModelSerializer):  
    class Meta:  
        model = STACItem  
        geo_field = 'geometry'  
        fields = ['id', 'collection', 'datetime', 'bbox', 'assets']
```



# 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)
```

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



Do we need a django-stac  
package?

# Asanteni!

