STAC and Landsat

Kristi Kline, Project Manager
USGS EROS
kkline@usgs.gov

Matthew Hanson
Element 84, Contractor to USGS
mhanson@element84.com

U.S. Department of the Interior
U.S. Geological Survey

The specification

- Catalogs
  - There's always a root catalog
  - Contains other catalogs and collections
- Collections
  - Can contain other catalogs (called sub-catalogs) to group Items further
    - e.g., For Landsat-8 there might be sub-catalog by Landsat Path and Row
  - Ultimately contains Items which are similar in some way(s)
    - e.g., same instrument, same region containing data from different instruments, etc.
- Items
  - A single scene or set of datafiles for a specific location at a specific date and time (when/where)

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https://earth-search.aws.element84.com/stac

+ - View source


```
{
   stac_version: "0.6.2",
   id: "earth-search",
   title: "Earth on AWS STAC API",
   description: "A STAC API powered by sat-api for Earth on AWS datasets by Element 84",
 - links: [
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/cbers4-awfi"
      },
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/cbers4-pan10m"
      },
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/cbers4-mux"
      },
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/sentinel-2-l1c"
      },
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/landsat-8-l1"
      },
    - {
         rel: "child",
         href: "https://earth-search.aws.element84.com/collections/cbers4-pan5m"
      },
    - {
         rel: "self",
         href: "https://earth-search.aws.element84.com/stac"
      }
   ]
}
```


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links

Links

Field Name	Type	Description
href	string	**REQUIRED.** The actual link in the format of an URL. Relative and absolute links are both allowed.
rel	string	**REQUIRED.** Relationship between the current document and the linked document. See chapter "Relation types" for more information.
type	string	Media type of the referenced entity.
title	string	A human readable title to be used in rendered displays of the link.

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Link Relation Types

Type	Description
self	STRONGLY RECOMMENDED. *Absolute* URL to the location that the catalog file can be found online, if available. This is particularly useful when in a download package that includes metadata, so that the downstream user can know where the data has come from.
root	STRONGLY RECOMMENDED. URL to the root STAC Catalog or Collection. Catalogs should include a link to their root, even if it's the root and points to itself.
parent	URL to the parent STAC Catalog or Collection. Non-root catalogs should include a link to their parent.
child	URL to a child STAC Catalog or Collection.
item	URL to a STAC Item.

Other Links: **about, derived-from, previous-version (any IANA rel type)**

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STAC Catalog

Element	Type	Description
stac_version	string	**REQUIRED.** The STAC version the catalog implements. STAC versions can be mixed, but please keep the recommended best practices in mind.
stac_extensions	[string]	A list of extension identifiers the Catalog implements.
id	string	**REQUIRED.** Identifier for the catalog.
title	string	A short descriptive one-line title for the catalog.
description	string	**REQUIRED.** Detailed multi-line description to fully explain the catalog. CommonMark 0.29 syntax MAY be used for rich text representation.
links	[Link Object]	**REQUIRED.** A list of references to other documents.

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STAC Collection

Element	Type	Description
stac_version	string	**REQUIRED.** The STAC version the Collection implements. STAC versions can be mixed, but please keep the recommended best practices in mind.
stac_extensions	[string]	A list of extension identifiers the Collection implements.
id	string	**REQUIRED.** Identifier for the collection that is unique across the provider.
title	string	A short descriptive one-line title for the collection.
description	string	**REQUIRED.** Detailed multi-line description to fully explain the collection. CommonMark 0.29 syntax MAY be used for rich text representation.
keywords	[string]	List of keywords describing the collection.
license	string	**REQUIRED.** Collection's license(s), either a SPDX License identifier, `various` if multiple licenses apply or `proprietary` for all other cases.
providers	[Provider Object]	A list of providers, which may include all organizations capturing or processing the data or the hosting provider. Providers should be listed in chronological order with the most recent provider being the last element of the list.
extent	Extent Object	**REQUIRED.** Spatial and temporal extents.
summaries	Map<string, [*]|Stats Object>	A map of property summaries, either a set of values or statistics such as a range.
links	[Link Object]	**REQUIRED.** A list of references to other documents.

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STAC Item

Field Name	Type	Description
stac_version	string	**REQUIRED.** The STAC version the Item implements.
stac_extensions	[string]	A list of extensions the Item implements.
id	string	**REQUIRED.** Provider identifier. As most geospatial assets are already defined by some identification scheme by the data provider it is recommended to simply use that ID. Data providers are advised to include sufficient information to make their IDs globally unique, including things like unique satellite IDs.
type	string	**REQUIRED.** Type of the GeoJSON Object. MUST be set to `Feature`.
geometry	GeoJSON Geometry Object	**REQUIRED.** Defines the full footprint of the asset represented by this item, formatted according to RFC 7946, section 3.1. The footprint should be the default GeoJSON geometry, though additional geometries can be included. Coordinates are specified in Longitude/Latitude or Longitude/Latitude/Elevation based on WGS 84.
bbox	[number]	**REQUIRED.** Bounding Box of the asset represented by this item, formatted according to RFC 7946, section 5.
properties	Properties Object	**REQUIRED.** A dictionary of additional metadata for the item.
links	[Link Object]	**REQUIRED.** List of link objects to resources and related URLs. A link with the `rel` set to `self` is strongly recommended.
assets	Map<string, Asset Object>	**REQUIRED.** Dictionary of asset objects that can be downloaded, each with a unique key.
collection	string	The `id` of the STAC Collection this Item references to (see `collection` relation type). This field is *required* if such a relation type is present. This field provides an easy way for a user to search for any Items that belong in a specified Collection.

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Item Properties

Field Name	Type	Description
datetime	string	**REQUIRED.** The searchable date and time of the assets, in UTC. It is formatted according to RFC 3339, section 5.6.
title	string	A human readable title describing the item.
start_datetime	string	The first or start date and time for the item, in UTC. It is formatted as `date-time` according to RFC 3339, section 5.6.
end_datetime	string	The last or end date and time for the item, in UTC. It is formatted as `date-time` according to RFC 3339, section 5.6.

Field Name	Type	Description
platform	string	Unique name of the specific platform to which the instrument is attached.
instruments	[string]	Name of instrument or sensor used (e.g., MODIS, ASTER, OLI, Canon F-1).
constellation	string	Name of the constellation to which the platform belongs.
mission	string	Name of the mission for which data is collected.

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Item Assets

Field Name	Type	Description
href	string	**REQUIRED.** Link to the asset object. Relative and absolute links are both allowed.
title	string	The displayed title for clients and users.
description	string	A description of the Asset providing additional details, such as how it was processed or created.
type	string	Media type of the asset.
roles	[string]	The semantic role of the asset, similar to the use of `rel` in links.

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Content Extensions

Extension Title	Identifier	Field Name Prefix	Scope	Maturity	Description
Asset Definition	asset	-	Collection	*Proposal*	Provides a way to specify details about what assets may be found in Items belonging to a collection.
Checksum	checksum	checksum	Item, Catalog, Collection	*Proposal*	Provides a way to specify file checksums for assets and links in Items, Catalogs and Collections.
Commons	commons	-	Item, Collection	*Proposal*	Provides a way to specify data fields in a collection that are common across the STAC Items in that collection, so that each does not need to repeat all the same information.
Data Cube	datacube	cube	Item, Collection	*Proposal*	Data Cube related metadata, especially to describe their dimensions.
Electro-Optical	eo	eo	Item	*Pilot*	Covers electro-optical data that represents a snapshot of the earth for a single date and time. It could consist of multiple spectral bands, for example visible bands, infrared bands, red edge bands and panchromatic bands. The extension provides common fields like bands, cloud cover, gsd and more.
Label	label	label	Item	*Proposal*	Items that relate labeled AOIs with source imagery

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Content Extensions

Extension Title	Identifier	Field Name Prefix	Scope	Maturity	Description
Point Cloud	pointcloud	pc	Item	*Proposal*	Provides a way to describe point cloud datasets. The point clouds can come from either active or passive sensors, and data is frequently acquired using tools such as LiDAR or coincidence-matched imagery.
Projection	projection	proj	Item	*Proposal*	Provides a way to describe items whose assets are in a geospatial projection.
SAR	sar	sar	Item	*Proposal*	Covers synthetic-aperture radar data that represents a snapshot of the earth for a single date and time.
Satellite	sat	sat	Item	*Proposal*	Satellite related metadata for data collected from satellites.
Scientific	scientific	sci	Item, Collection	*Proposal*	Scientific metadata is considered to be data that indicate from which publication data originates and how the data itself should be cited or referenced.
Single File STAC	single-file-stac	-	ItemCollection	*Proposal*	An extension to provide a set of Collections and Items as a single file catalog.
Tiled Assets	tiled-assets	tiles	Item, Catalog, Collection	*Proposal*	Allows to specify numerous assets using asset templates via tile matrices and dimensions.
Versioning Indicators	version	-	Item, Collection	*Proposal*	Provides fields and link relation types to provide a version and indicate deprecation.
View Geometry	view	view	Item	*Proposal*	View Geometry adds metadata related to angles of sensors and other radiance angles that affect the view of resulting data

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STAC Extensions used for Landsat

- EO
- Satellite
- View Geometry

Other relevant extensions

- Checksum
- Projection
- Scientific
- Versioning Indicators

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Electro-Optical Extension

Properties

Field Name	Type	Description
eo:gsd	number	**REQUIRED.** Ground Sample Distance at the sensor.
eo:bands	[Band Object]	**REQUIRED.** This is a list of the available bands where each item is a Band Object.
eo:cloud_cover	number	Estimate of cloud cover as a percentage (0-100) of the entire scene. If not available the field should not be provided.

Bands object

Field Name	Type	Description
name	string	The name of the band (e.g., "B01", "B02", "B1", "B5", "QA").
common_name	string	The name commonly used to refer to the band to make it easier to search for bands across instruments. See the list of accepted common names.
description	string	Description to fully explain the band. CommonMark 0.29 syntax MAY be used for rich text representation.
center_wavelength	number	The center wavelength of the band, in micrometers (μm).
full_width_half_max	number	Full width at half maximum (FWHM). The width of the band, as measured at half the maximum transmission, in micrometers (μm).

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Spectral Band Common Names

Common Name	Band Range (µm)	Landsat 5/7	Landsat 8	Sentinel 2	MODIS
coastal	0.40 - 0.45		1	1	
blue	0.45 - 0.50	1	2	2	3
green	0.50 - 0.60	2	3	3	4
red	0.60 - 0.70	3	4	4	1
yellow	0.58 - 0.62				
pan	0.50 - 0.70	8 (*L7 only*)	8		
rededge	0.70 - 0.75				
nir	0.75 - 1.00	4		8	2
nir08	0.75 - 0.90		5	8a	
nir09	0.85 - 1.05			9	
cirrus	1.35 - 1.40		9	10	26
swir16	1.55 - 1.75	5	6	11	6
swir22	2.10 - 2.30	7	7	12	7
lwir	10.5 - 12.5	6			
lwir11	10.5 - 11.5		10		31
lwir12	11.5 - 12.5		11		32

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Satellite and View Geometry Extensions

Field Name	Type	Description
sat:orbit_state	string	The state of the orbit. Either `ascending` or `descending` for polar orbiting satellites, or `geostationary` for geosynchronous satellites
sat:relative_orbit	integer	The relative orbit number at the time of acquisition.

Field Name	Type	Description
view:off_nadir	number	The angle from the sensor between nadir (straight down) and the scene center. Measured in degrees (0-90).
view:incidence_angle	number	The incidence angle is the angle between the vertical (normal) to the intercepting surface and the line of sight back to the satellite at the scene center. Measured in degrees (0-90).
view:azimuth	number	Viewing azimuth angle. The angle measured from the sub-satellite point (point on the ground below the platform) between the scene center and true north. Measured clockwise from north in degrees (0-360).
view:sun_azimuth	number	Sun azimuth angle. From the scene center point on the ground, this is the angle between truth north and the sun. Measured clockwise in degrees (0-360).
view:sun_elevation	number	Sun elevation angle. The angle from the tangent of the scene center point to the sun. Measured from the horizon in degrees (0-90).

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Landsat STAC Collection


```
{
    "id": "landsat-c2-l1",
    "title": "Landsat Collection 2 L1",
    "description": "Landat 8 imagery radiometrically calibrated and orthorectified using gound point
    "keywords": [
        "landsat",
        "earth observation",
        "usgs"
    ],
    "stac_version": "1.0.0-b1",
    "stac_extensions": [
        "asset"
    ],
    "extent": {
        "spatial": [
            -180,
            -90,
            180,
            90
        ],
        "temporal": [
            "1982-07-16",
            null
        ]
    },
    "providers": [
        {
            "name": "USGS",
```


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Landsat STAC Item


```
{
    "stac_version": "1.0.0-b1",
    "stac_extensions": [
        "eo",
        "satellite",
        "view",
        "https://example.com/stac/landsat-extension/1.0/schema.json"
    ],
    "id": "LC08_L2SP_224078_20180513_20200417_02_T1",
    "collection": "landsat-c2-l2-sr",
    "type": "Feature",
    "bbox": [
        -56.09283968138202,
        -27.07081801309046,
        -53.7271800117186,
        -24.912376374692244
    ],
    "geometry": {
        "type": "Polygon",
        "coordinates": [
            [
                [
                    -55.62426269227002,
                    -24.94557731902174
                ],
                [
                    -55.893596743570484,
                    -26.005890844517793
```