

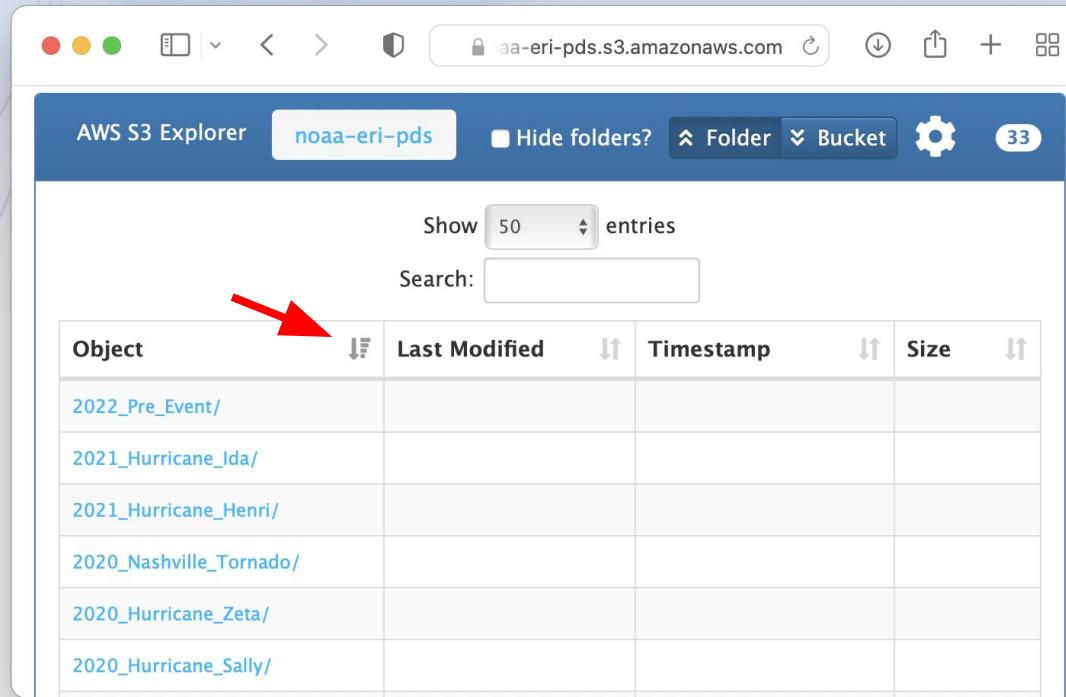


Using Emergency Response and Pre-Event Imagery from NOAA's Big Data Program with Free and Open Source Software

<https://www.noaa.gov/information-technology/big-data>

Using the Bucket Browser

<https://noaa-eri-pds.s3.amazonaws.com/index.html>



The screenshot shows the AWS S3 Explorer interface for the 'noaa-eri-pds' bucket. The interface includes a toolbar with file operations and navigation buttons, and a main area for managing objects. The main area features a table with columns for Object, Last Modified, Timestamp, and Size. The 'Object' column contains folder names related to various events. A red arrow points to the 'Object' column header.

Object	Last Modified	Timestamp	Size
2022_Pre_Event/			
2021_Hurricane_Ida/			
2021_Hurricane_Henri/			
2020_Nashville_Tornado/			
2020_Hurricane_Zeta/			
2020_Hurricane_Sally/			

Pro tip: If you just want to view the imagery visit <https://storms.ngs.noaa.gov/> for storm viewers and links to Web Map Tile Services (WMTS)

Directory Structure for Hurricane Laura 2020 to Present*

The image shows two screenshots of the AWS S3 Explorer interface. The left screenshot displays the main directory structure for Hurricane Laura, 2020 to present. The right screenshot shows a detailed view of the raw data for August 31, 2021.

Left Screenshot (Main Directory):

- Bucket: noaa-eri-pds / 2021_Hurricane_Ida
- Object list:

 - downloads/
 - 20210902b_RGB/
 - 20210902a_RGB/
 - 20210901b_RGB/
 - 20210901a_RGB/
 - 20210831b_RGB/
 - 20210831a_RGB/ (highlighted)
 - 20210830h_RGB/

Right Screenshot (Detailed View):

- Bucket: noaa-eri-pds / 2021_Hurricane_Ida / 20210831a_RGB
- Object list:

 - raw/ (highlighted)
 - tile_index_20210831a_RGB.tar
 - tile_index_20210831a_RGB.shx
 - tile_index_20210831a_RGB.shp
 - tile_index_20210831a_RGB.prj
 - tile_index_20210831a_RGB.dbf
 - cogs_20210831a_RGB.vrt
 - 20210831aC0910600w294415n.tif

Annotations:

- RAW data for this group → points to the raw/ folder in the detailed view.
- Tile index for this group → points to the tile_index files.
- GDAL Virtual Format¹ → points to the cogs_20210831a_RGB.vrt file.
- Cloud Optimized Geotiff (COG)² → points to the 20210831aC0910600w294415n.tif file.

¹<https://gdal.org/drivers/raster/vrt.html#vrt-gdal-virtual-format>

²<https://www.cogeo.org>

*Prior to 2020 only the Cloud Optimized Geotiff data are available via this portal.

RAW Data

Exterior Orientation

- may not be available for all flights
- may contain references to data not in this group

Footprint index and tile schema

JPEG image

Geometry file (next slide)

The screenshot shows the AWS S3 Explorer interface. The URL in the address bar is `noaa-eri-pds.s3.amazonaws.com`. The path in the address bar is `noaa-eri-pds / 2021_Hurricane_Ida / 20210831a_RGB / raw`. The interface includes a toolbar with icons for Hide folders?, Folder, Bucket, and a gear icon. A status bar at the bottom right shows "2353". Below the toolbar is a search bar with placeholder text "Search:" and a "Show 50 entries" button. The main area is a table listing objects:

Object	Last Modified	Timestamp	Size
243_batch_RGB_2_Oblique_EO.txt	3 months ago	2021-08-31 23:31:51	96 KB
243_batch_RGB_1_Oblique_EO.txt	3 months ago	2021-08-31 23:31:51	95 KB
20210831a.sqlite	3 months ago	2021-08-31 23:31:51	1 MB
022654-0831212053032-RGB2.jpg	3 months ago	2021-08-31 23:31:51	37 MB
022654-0831212053032-RGB2.geom	3 months ago	2021-08-31 23:31:51	3 KB
022653-0831212052548-RGB2.jpg	3 months ago	2021-08-31 23:31:51	37 MB
022653-0831212052548-RGB2.geom	3 months ago	2021-08-31 23:31:51	3 KB
022652-0831212052464-RGB2.jpg	3 months ago	2021-08-31 23:31:50	40 MB

Geometry file

The OSSIM³ geometry file (.geom) is used during orthorectification of the imagery. It contains all of the interior and exterior orientation parameters for the camera. Each directory may contain images from multiple cameras. Some parameters that may be useful to advanced users are shown.

```
...
distortion.center: 0 0
distortion.convergence_threshold: 1e-05
distortion.dxdy: 0.0052 0.0052
distortion.k0: -2.88559891337079e-08
distortion.k1: -1.39659435252217e-05
distortion.k2: 3.8231137376565e-09
distortion.k3: -1.04476955995087e-13
distortion.max_iterations: 10
distortion.type: ossimMeanRadialLensDistortion
ecef_platform_position: -194257.970578342 -5511483.02673332 3194679.9333477
focal_length: 51.588
image_id: C28570029
kappa: 101.45834
latlonh_platform_position: 30.250081405699 -92.0186139175529 651.074 WGE
ll_lat: 30.2479079361336
ll_lon: -92.0152570619964
lr_lat: 30.2540936817812
lr_lon: -92.0164591284596
meters_per_pixel_x: 0.0658892609459362
meters_per_pixel_y: 0.0658892609459362
number_lines: 7760
number_of_adjustments: 1
number_samples: 10328
omega: 3.48179
phi: -0.69092
pixel_size: 0.0052 0.0052
principal_point: -0.133 0.266
...
```

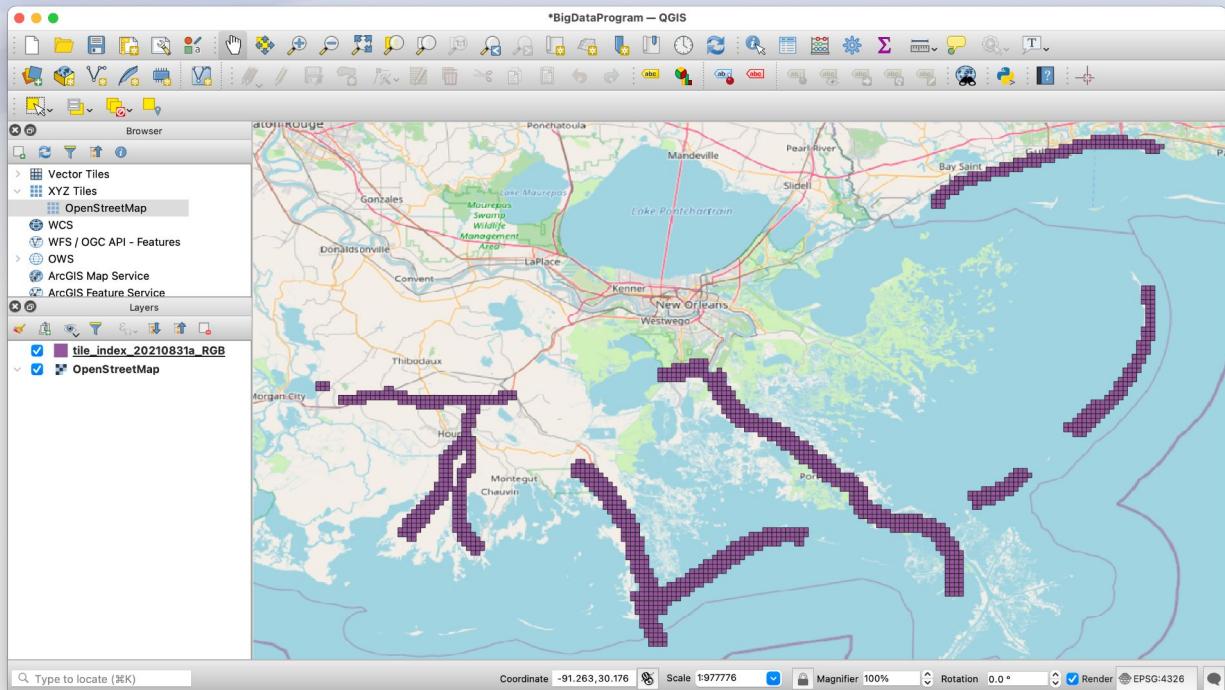
³<https://github.com/ossimlabs/ossim>

Using the data in Quantum GIS⁴

Download the tile index tar file
(mentioned previously)

Drag and drop into QGIS
- Or extract and load the SHP

Load the OpenStreetMap layer for
reference (available by default) or
other basemap data



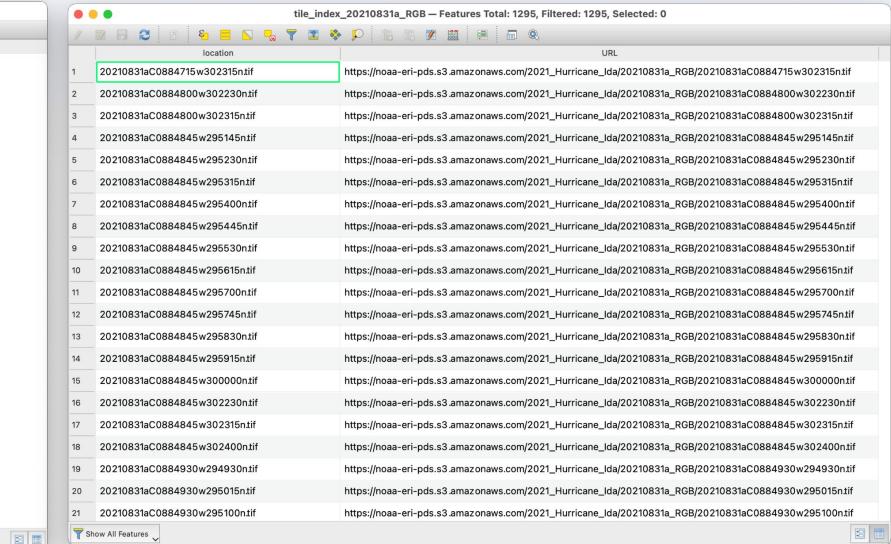
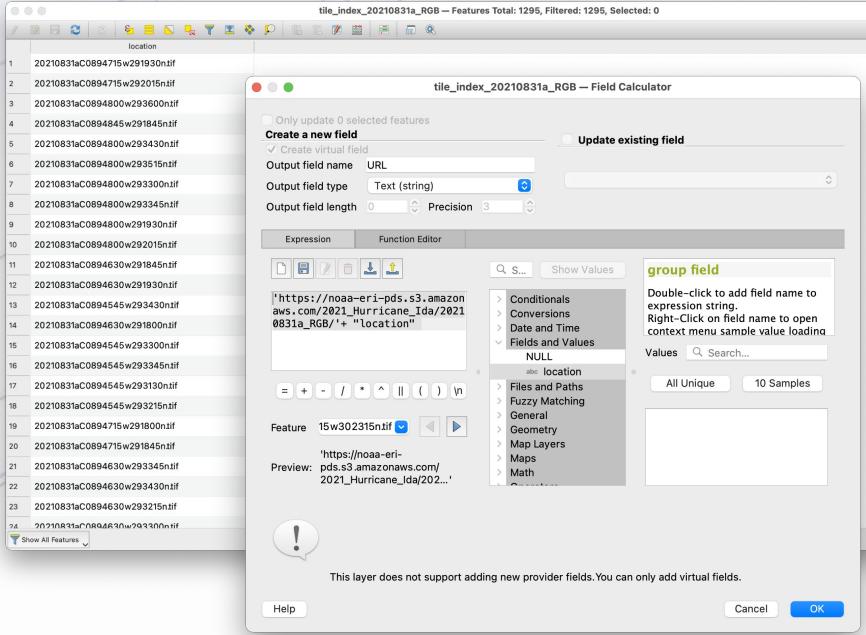
⁴<https://qgis.org/en/site/>

Edit the attributes to create download URLs

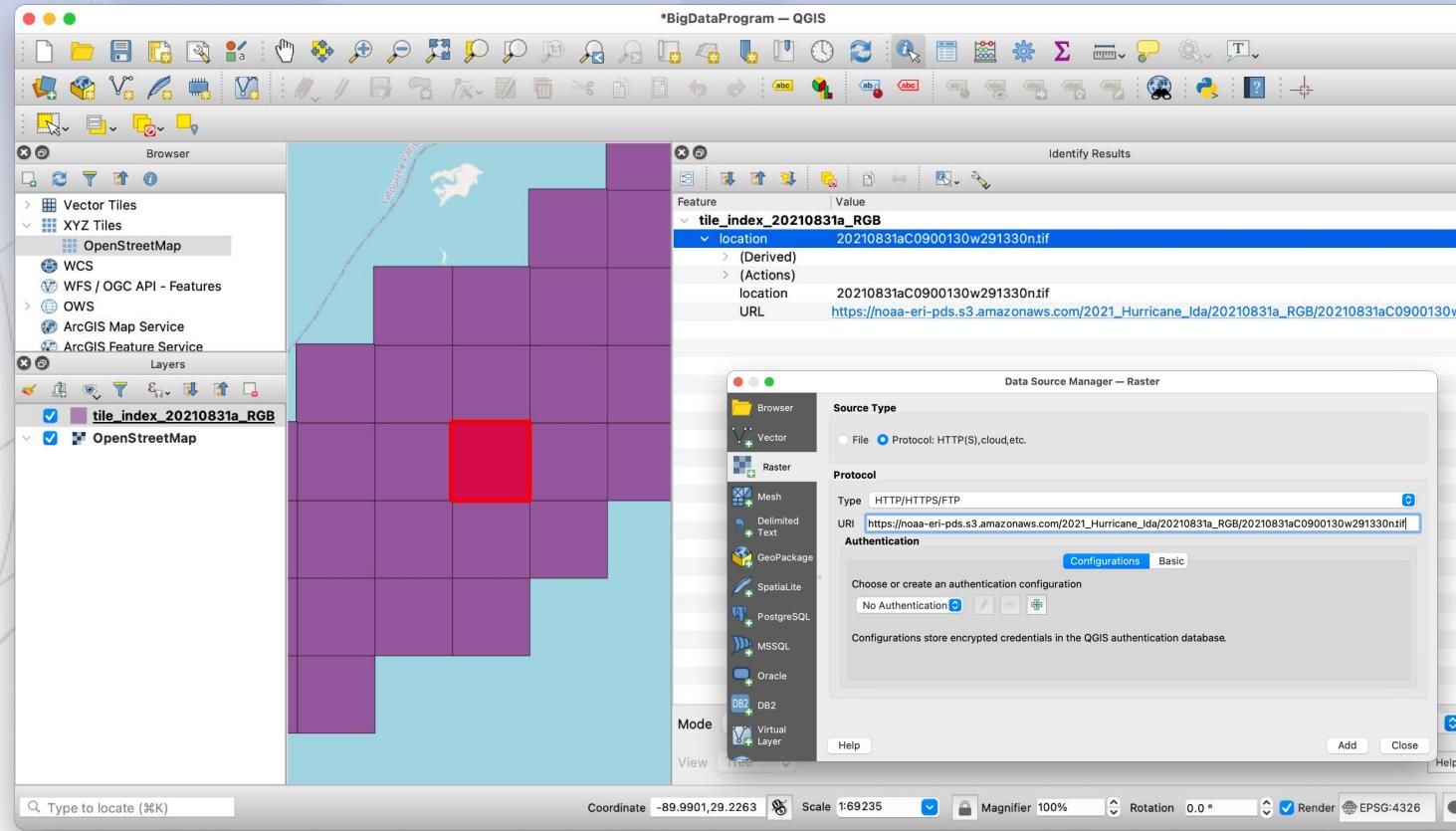
Use the “Field Calculator” to create a virtual field containing download links.

Be sure to use the correct path (unique for each group) and note the single quotes vs double quotes.

'https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/' + "location"



Using the COGs in Quantum GIS



Pro tip: The WMTS will load faster and provide full coverage. The individual COGs are better for users that want to analyze or save the image.
Ida WMTS: <https://storms.ngs.noaa.gov/storms/ida/services/WMTSCapabilities.xml> See: <https://storms.ngs.noaa.gov> for a list of all storms.

*BigDataProgram — QGIS

Browser

- > Vector Tiles
- > XYZ Tiles
 - OpenStreetMap
- > WCS
- > WFS / OGC API - Features
- > OWS
- ArcGIS Map Service
- ArcGIS Feature Service

Layers

- 20210831aC0900130w291330n
- tile_index_20210831a_RGB
- OpenStreetMap

Type to locate (⌘K)

Coordinate -90.0209240,29.2186497

Scale 1:712

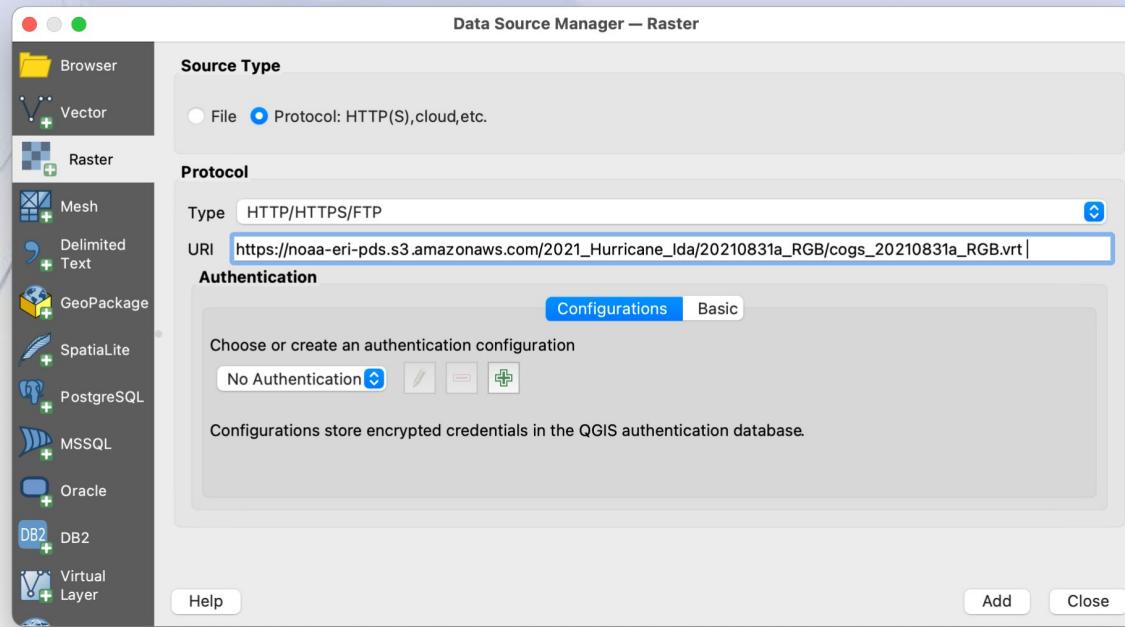
Magnifier 100%

Rotation 0.0 °

Render

EPSG:4326

Using the COG VRTs* in Quantum GIS



* Zoom into scales of 1:10,000 or larger prior to loading for optimal performance

Using the GDAL Command Line Interface (CLI)⁵

Get information about a particular COG (note the /vsicurl/ prefix*):

```
gdalinfo /vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/20210831aC0910045w294200n.tif
Driver: GTiff/GeoTIFF
Files: /vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/20210831aC0910045w294200n.tif
Size is 9415, 9415
Coordinate System is:
GEOGCRS["WGS 84",
  DATUM["World Geodetic System 1984",
    ELLIPSOID["WGS 84",6378137,298.257223563,
      LENGTHUNIT["metre",1]],
    PRIMEM["Greenwich",0,
      ANGLEUNIT["degree",0.0174532925199433]],
    CS[ellipsoidal,2],
    AXIS["geographic latitude (Lat)",north,
      ORDER[1],
      ANGLEUNIT["degree",0.0174532925199433]],
    AXIS["geographic longitude (Lon)",east,
      ORDER[2],
      ANGLEUNIT["degree",0.0174532925199433]],
    ID["EPSG",4326]]
  Data axis to CRS axis mapping: 2,1
  Origin = (-91.01260000000006,29.70009999999999)
  Pixel Size = (0.000001348911312,-0.000001348911312)
Metadata:
  AREA_OR_POINT=Point
  TIFFTAG_DATETIME=2021:08:31 23:59:59
  TIFFTAG_MAXSAMPLEVALUE=0
  TIFFTAG_MINSAMPLEVALUE=1
Image Structure Metadata:
  COMPRESSION=LZW
  INTERLEAVE=PIXEL
```

Corner Coordinates:
Upper Left (-91.0126000, 29.7001000) (91d 0'45.36"W, 29d42' 0.36"N)
Lower Left (-91.0126000, 29.6874000) (91d 0'45.36"W, 29d41'14.64"N)
Upper Right (-90.9999000, 29.7001000) (90d59'59.64"W, 29d42' 0.36"N)
Lower Right (-90.9999000, 29.6874000) (90d59'59.64"W, 29d41'14.64"N)
Center (-91.0062500, 29.6937500) (91d 0'22.50"W, 29d41'37.50"N)
Band 1 Block=512x512 Type=Byte, ColorInterp=Red
 Overviews: 4707x4707, 2353x2353, 1176x1176, 588x588, 294x294
 Mask Flags: PER_DATASET ALPHA
Band 2 Block=512x512 Type=Byte, ColorInterp=Green
 Overviews: 4707x4707, 2353x2353, 1176x1176, 588x588, 294x294
 Mask Flags: PER_DATASET ALPHA
Band 3 Block=512x512 Type=Byte, ColorInterp=Blue
 Overviews: 4707x4707, 2353x2353, 1176x1176, 588x588, 294x294
 Mask Flags: PER_DATASET ALPHA
Band 4 Block=512x512 Type=Byte, ColorInterp=Alpha
 Overviews: 4707x4707, 2353x2353, 1176x1176, 588x588, 294x294

⁵<https://gdal.org/programs/index.html#raster-programs>

GDAL is available for Linux, Mac and Windows. Ubuntu Linux 20.04 was used for this demo.

*The /vsicurl/ prefix tells GDAL to use its built in Virtual File System driver

*This driver may also allow you to access the data using programs with GDAL raster support such as ESRI
<https://doc.arcgis.com/en/imagery/workflows/best-practices/storing-imagery-in-the-cloud.htm>

Using the GDAL CLI

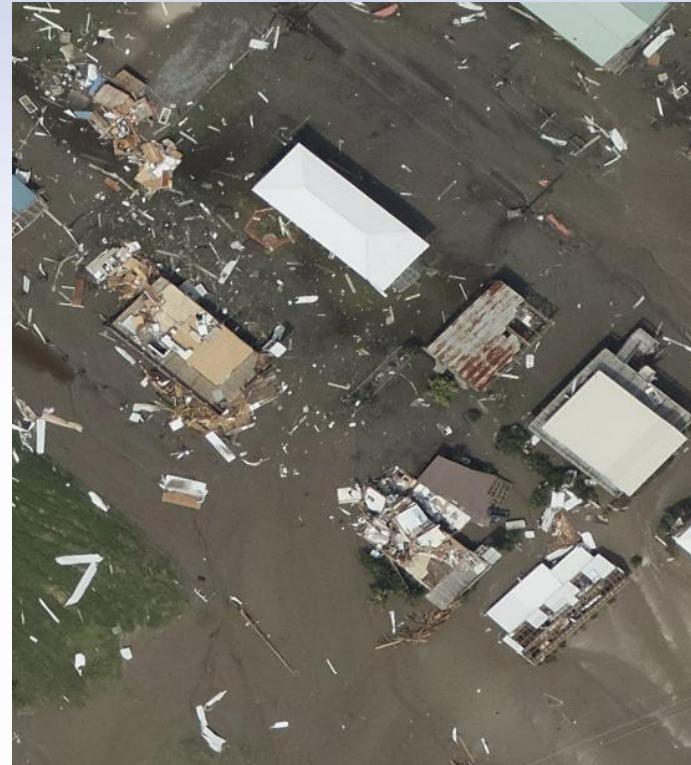
Get information about a particular COG VRT:

```
gdalinfo /vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/cogs_20210831a_RGB.vrt
Driver: VRT/Virtual Raster
Files: /vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/cogs_20210831a_RGB.vrt
       /vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/20210831aC0884715w302315n.tif
...
<1293 tif files>
...
/vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/20210831a_RGB/20210831aC0910600w294415n.tif
Size is 1723760, 1038022
Coordinate System is:
GEOGCRS["WGS 84",
  DATUM["World Geodetic System 1984",
    ELLIPSOID["WGS 84",6378137,298.257223563,
      LENGTHUNIT["metre",1]]],
  PRIMEM["Greenwich",0,
    ANGLEUNIT["degree",0.0174532925199433]],
  CS[ellipsoidal,2],
  AXIS["geodetic latitude (Lat)",north,
    ORDER[1],
    ANGLEUNIT["degree",0.0174532925199433]],
  AXIS["geodetic longitude (Lon)",east,
    ORDER[2],
    ANGLEUNIT["degree",0.0174532925199433]],
  ID["EPSG",4326]]
Data axis to CRS axis mapping: 2,1
Origin = (-91.1000999999998,30.412600000000001)
Pixel Size = (0.000001348911312,-0.000001348911312)
Corner Coordinates:
Upper Left (-91.1001000, 30.4126000) ( 91d 6' 0.36"W, 30d24'45.36"N)
Lower Left (-91.1001000, 29.0124004) ( 91d 6' 0.36"W, 29d 0'44.64"N)
Upper Right (-88.7749006, 30.4126000) ( 88d46'29.64"W, 30d24'45.36"N)
Lower Right (-88.7749006, 29.0124004) ( 88d46'29.64"W, 29d 0'44.64"N)
Center (-89.9375003, 29.7125002) ( 89d56'15.00"W, 29d42'45.00"N)
Band 1 Block=128x128 Type=Byte, ColorInterp=Red
  Mask Flags: PER_DATASET
Band 2 Block=128x128 Type=Byte, ColorInterp=Green
  Mask Flags: PER_DATASET
Band 3 Block=128x128 Type=Byte, ColorInterp=Blue
  Mask Flags: PER_DATASET
```

Using the GDAL CLI

The VRT file allows you to treat the 1295 mosaic COGs (~210 GB of data!) in this group as a single file without having to download the entire dataset. This facilitates some interesting possibilities. For example, the following command will subset a section of Grand Isle, LA in a couple of seconds

```
gdal_translate -projwin -90.02114 29.21892 -90.02040 29.21809  
"/vsicurl/https://noaa-eri-pds.s3.amazonaws.com/2021_Hurricane_Ida/2021083  
1a_RGB/cogs_20210831a_RGB.vrt" 20210831a_subset.jpg  
Input file size is 1723760, 1038022  
0...10...20...30...40...50...60...70...80...90...100 - done.
```



The output image can be any supported GDAL format. JPG was selected as an example.