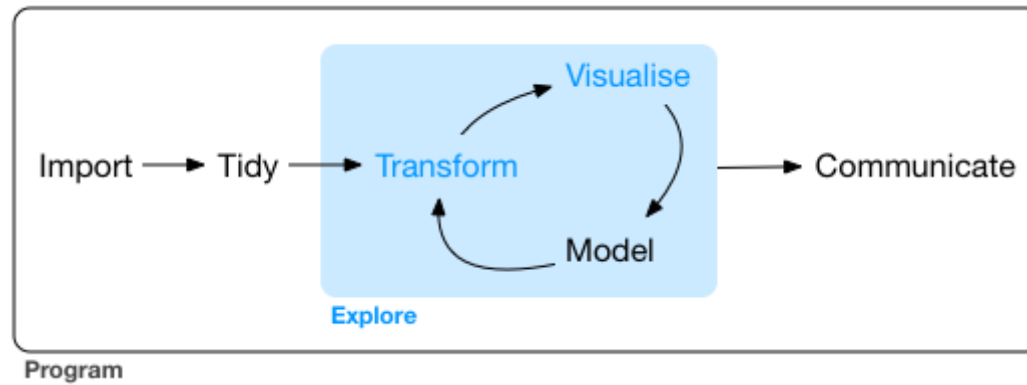


Cloud-native Geospatial

with Pangeo and the Microsoft Planetary Computer

Tom Augspurger

May 2023



[R for Data Science \(Wickham & Grolemund\)](#)

Components

Data, APIs, Compute

Data Catalog

The Planetary Computer Data Catalog includes petabytes of environmental monitoring data, in consistent, analysis-ready formats. All of the datasets below can be accessed via Azure Blob Storage, and can be used by developers whether you're working within or outside of our Planetary Computer Hub.

Featured

Air Quality

Biodiversity

Biomass/Vegetation

Climate/Weather

DEMs

Demographics

Fire

Imagery

Infrastructure

Land use/Land cover

SAR

Snow

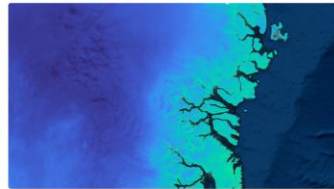
Featured



Landsat Collection

The Landsat program provides a comprehensive, continuous archive of multispectral imagery of the Earth's surface from 1972 to present.

Landsat USGS NASA Satellite Global Imagery ...



MODIS Version 6.1 Products

The MODIS instrument operates on both the Terra and Aqua spacecraft, covering the entire surface of the Earth within one or two days. The derived data products describe atmosphere, cryosphere, land, and ocean features utilized in studies across various disciplines.

MODIS NASA USGS Satellite Global Imagery ...



Sentinel-1 Synthetic Aperture Radar (SAR)

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

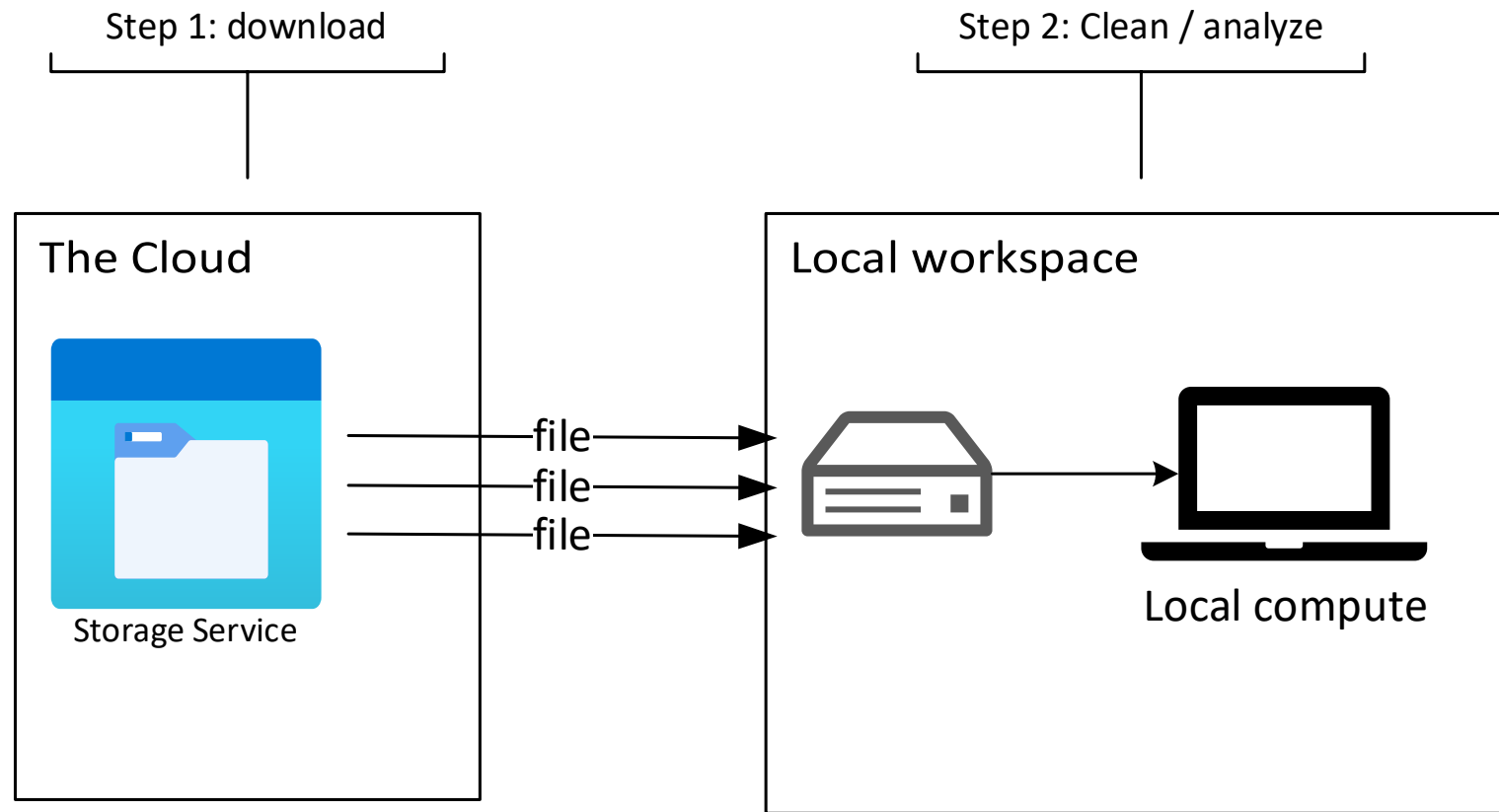
ESA Copernicus Sentinel C-Band SAR



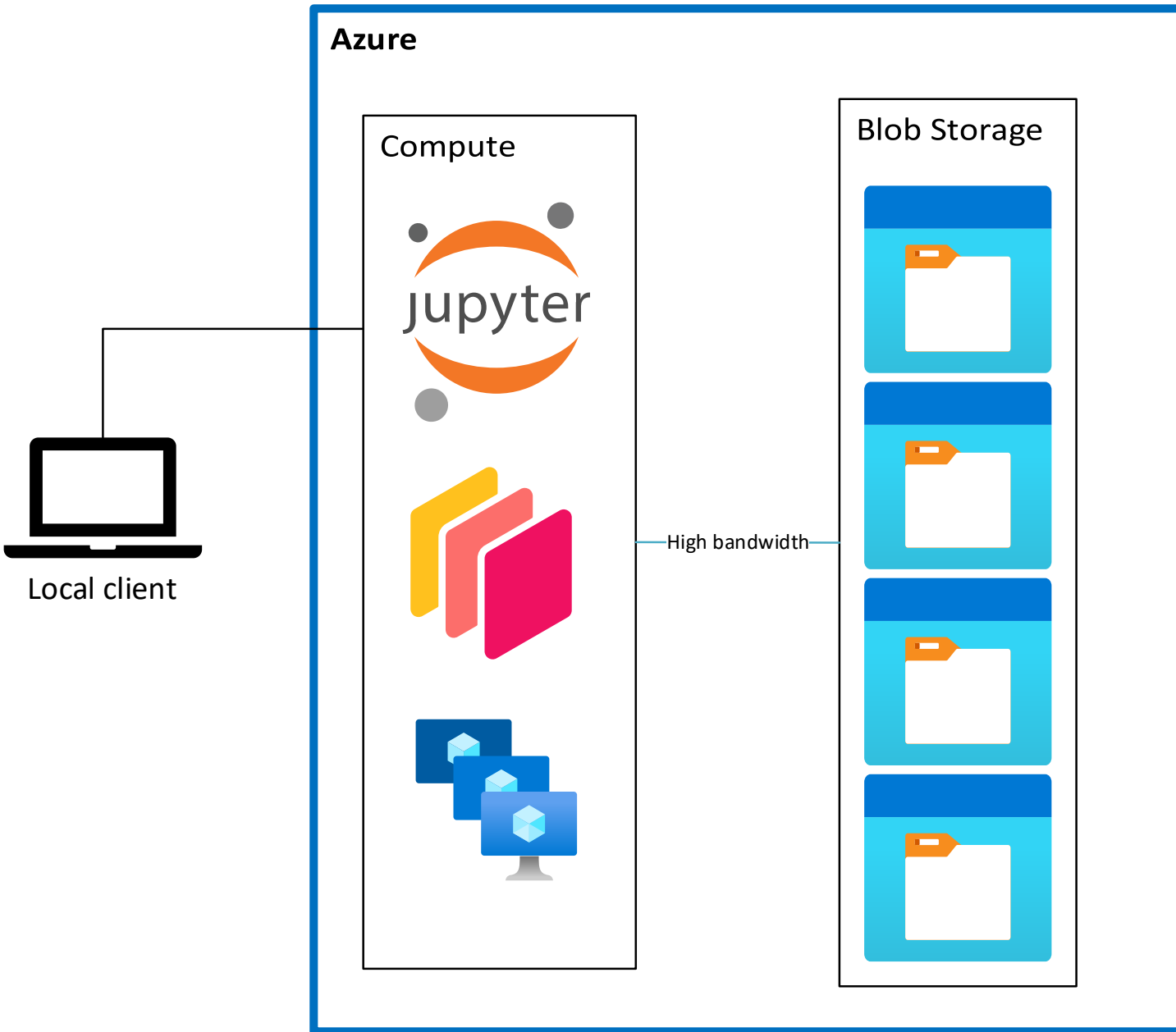
Sentinel-2 Level-2A

Data Access

The "Download" Model



The "Cloud-Native" Model



Files on Blob Storage isn't enough

- Find all the Sentinel-2 images over Wyoming in 2022
- Now do that for GOES-CMI, which has a completely different naming scheme

```
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/06/52B_MSIL2A_20220106T110249_N0300_R065_T24CV_20220107T061757_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/07/52B_MSIL2A_20220107T103149_N0300_R079_T24CV_20220108T001941_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/08/52B_MSIL2A_20220108T100049_N0300_R093_T24CV_20220110T198345_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/12/52B_MSIL2A_20220112T094019_N0300_R007_T24CV_20220113T052312_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/16/52B_MSIL2A_20220116T110249_N0300_R065_T24CV_20220116T203033_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/17/52B_MSIL2A_20220117T103149_N0300_R079_T24CV_20220118T000635_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/18/52B_MSIL2A_20220118T100049_N0300_R093_T24CV_20220119T051310_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/22/52B_MSIL2A_20220122T094009_N0300_R007_T24CV_20220123T060450_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/26/52B_MSIL2A_20220126T110249_N0400_R065_T24CV_20220127T120959_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/26/52B_MSIL2A_20220126T110249_N0400_R065_T24CV_20220127T223636_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/26/52B_MSIL2A_20220126T110249_N0400_R065_T24CV_20220226T154026_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/26/52B_MSIL2A_20220126T110249_N0400_R065_T24CV_20220227T123006_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/27/52B_MSIL2A_20220127T103149_N0400_R079_T24CV_20220227T145052_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/27/52B_MSIL2A_20220127T103149_N0400_R079_T24CV_20220227T181053_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/01/28/52B_MSIL2A_20220128T100049_N0400_R093_T24CV_20220227T13706038_SAFE',
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'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/06/52B_MSIL2A_20220206T103149_N0400_R079_T24CV_20220219T125245_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/07/52B_MSIL2A_20220207T100049_N0400_R093_T24CV_20220220T080317_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/11/52B_MSIL2A_20220211T094009_N0400_R007_T24CV_20220221T054409_SAFE',
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'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/16/52B_MSIL2A_20220216T103149_N0400_R079_T24CV_20220224T021609_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/17/52B_MSIL2A_20220217T100049_N0400_R093_T24CV_20220224T143913_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/21/52B_MSIL2A_20220221T094009_N0400_R007_T24CV_20220228T025132_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/25/52B_MSIL2A_20220225T110249_N0400_R065_T24CV_20220301T231013_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/26/52B_MSIL2A_20220226T103149_N0400_R079_T24CV_20220302T081011_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/02/27/52B_MSIL2A_20220227T100049_N0400_R093_T24CV_20220302T190611_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/03/52B_MSIL2A_20220303T094019_N0400_R007_T24CV_20220305T091626_SAFE',
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'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/16/52B_MSIL2A_20220316T11259_N0400_R108_T24CV_20220317T034001_SAFE',
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'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/25/52B_MSIL2A_20220325T100059_N0400_R093_T24CV_20220326T021837_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/26/52B_MSIL2A_20220326T11259_N0400_R108_T24CV_20220327T040046_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/27/52B_MSIL2A_20220327T104209_N0400_R127_T24CV_20220328T045505_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/28/52B_MSIL2A_20220328T101119_N0400_R130_T24CV_20220329T000724_SAFE',
'https://sentinel2l2a01.blob.core.windows.net/sentinel2-l2/24/C/VV/2022/03/29/52B_MSIL2A_20220329T094019_N0400_R007_T24CV_20220330T023207_SAFE',
```


STAC for data access

- Find all the Sentinel-2 images over Wyoming in 2022

```
>>> import pystac_client
>>> catalog = pystac_client.Client.open(
...     "https://planetarycomputer.microsoft.com/api/stac/v1/"
... )

>>> items = catalog.search(
...     collections="sentinel-2-l2a",
...     intersects=aoi,
...     datetime="2022",
...     query={"eo:cloud_cover": {"lt": 10}}
... )
```

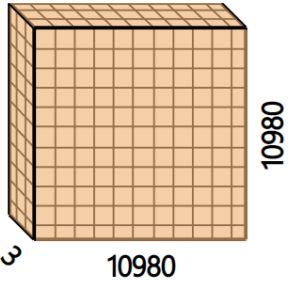
STAC to Data Containers

```
stackstac.stack(items, assets=["B02", "B03", "B04"])
```

xarray.DataArray 'stackstac-fc76776ea959d6b0c7ef7628e81b8d2c' (time: 67, band: 3, y: 10980, x: 10980)



	Array	Chunk
Bytes	180.55 GiB	8.00 MiB
Shape	(67, 3, 10980, 10980)	(1, 1, 1024, 1024)
Dask graph	24321 chunks in 3 graph layers	
Data type	float64 numpy.ndarray	



► Coordinates: (46)

► Indexes: (4)

▼ Attributes:

- spec : RasterSpec(epsg=32613, bounds=(499980.0, 4490220.0, 609780.0, 4600020.0), resolutions_xy=(10.0, 10.0))
- crs : epsg:32613
- transform : | 10.00, 0.00, 499980.00|
| 0.00,-10.00, 4600020.00|
| 0.00, 0.00, 1.00|
- resolution : 10.0

Files + STAC isn't (always) enough

	Download	Cloud-native
Download	0.5	-
Metadata	0.02	1.5
Data	0.5	1.5
Total	1.02 seconds	3.0 seconds

Time to read a variable from a National Water Model file.

Cloud Optimized Assets (and clients)

- We'll sometimes do data conversions
 - Consolidated metadata
 - Efficient access subsets of the data
- Depends on the use-case

Explorer

The screenshot displays the Microsoft Planetary Computer Explorer interface. At the top, the Microsoft logo and 'Planetary Computer' are visible, along with navigation links for 'Explore', 'Data Catalog', 'Hub', 'Applications', and 'Documentation'. A 'Request access' button is located in the top right corner. The main content area is divided into a left sidebar and a central map.

Explore datasets (Advanced | Clear)

- Sentinel 1 Radiometrically Terrain Corrected (RTC)
- Most recent - VV, VH
- VV, VH False-color composite

Sentinel 1 Radiometrically Terrain Corrected (RTC) ...

Showing the first 50 items that matched your filter.

	S1A_IW_GRDH_1SDV_20221021T132825_2021021T132850_045541_0571BE_rtc 10/21/2022 13:28:25 UTC — 10/21/2022 13:28:50 UTC
	S1A_IW_GRDH_1SDV_20221017T012527_2021017T012552_045475_057019_rtc 10/17/2022 01:25:27 UTC — 10/17/2022 01:25:52 UTC
	S1A_IW_GRDH_1SDV_20221009T132825_2021009T132850_045366_056C91_rtc 10/09/2022 13:28:25 UTC — 10/09/2022 13:28:50 UTC
	S1A_IW_GRDH_1SDV_20221005T012526_2021005T012551_045300_056A6B_rtc 10/05/2022 01:25:26 UTC — 10/05/2022 01:25:51 UTC
	S1A_IW_GRDH_1SDV_20220927T132825_20220927T132850_045191_056686_rtc

Explore results in the Hub

The central map shows a satellite view of a region with the label 'Sohbatpur'. A hand cursor is visible over the map. The bottom right corner of the map area contains the text '©2022 TomTom'.

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Explorer

The screenshot displays the Microsoft Planetary Computer Explorer interface. At the top, the Microsoft logo is followed by the text "Planetary Computer" and navigation links for "Explore", "Data Catalog", "Hub", "Applications", and "Documentation". A "Request access" button is located in the top right corner.

The main interface is divided into several sections:

- Explore datasets:** A search bar contains "Microsoft Building Footprints". Below it, there are dropdown menus for "Global" and "Default".
- Microsoft Building Footprints:** A section titled "Showing 6 items that matched your filter." lists several datasets with thumbnail images and dates:
 - Oceania_2022-06-14 (06/14/2022 00:00:00 UTC)
 - Cambodia_2022-06-14 (02/01/2015 — 05/11/2021)
 - Vietnam_2022-06-14 (12/28/2014 — 05/11/2021)
 - Thailand_2022-06-14 (04/05/2014 — 05/18/2020)

A blue button at the bottom of this section says "Explore results in the Hub".

The central part of the interface is a map of Cambodia, showing building footprints in blue and grey. The word "CAMBODIA" is prominently displayed in the center of the map. Various geographical features and locations are labeled, including "Phnom Penh", "Tay Ninh", "Binh Phuoc", and "Long".

On the right side of the map, there is a vertical toolbar with icons for navigation (compass, zoom in, zoom out, home, search, settings) and a legend. The legend shows two active layers:

- Microsoft Building Footprints:** Global | Default
- Sentinel-2 Level-2A:** Most recent (low cloud) | Natural color

At the bottom right of the map, there is a copyright notice: "©2023 TomTom".

https://ai4datasetspublicassets.azureedge.net/assets/pc_video/vector-tile-ms-buildings-feature.mp4

Planetary Computer Summary

- Data on Azure Blob Storage
- STAC metadata for each dataset
- APIs for querying & visualizing the data
- Cloud-Optimized assets (sometimes)

Thanks!

<https://planetarycomputer.microsoft.com>

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