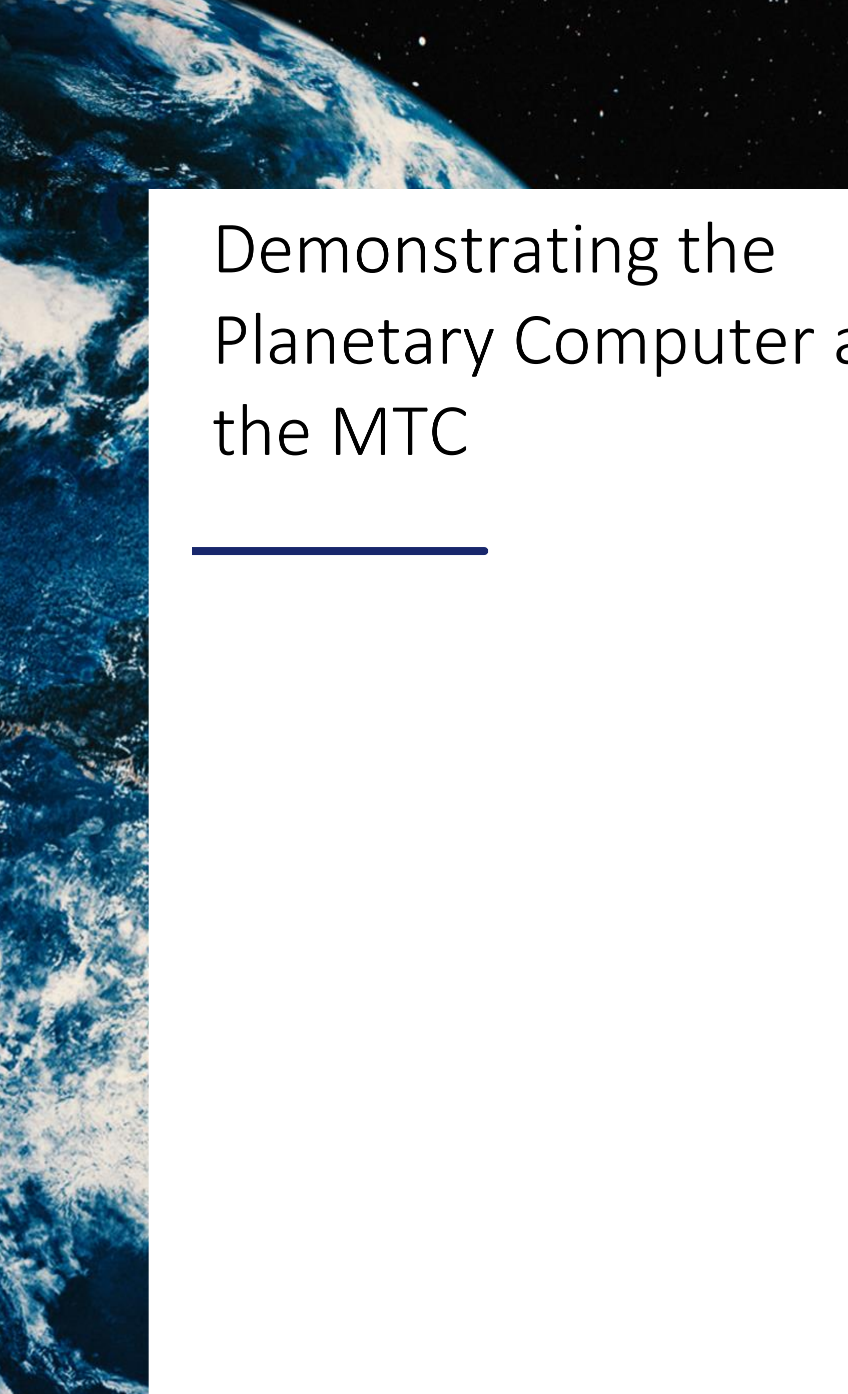

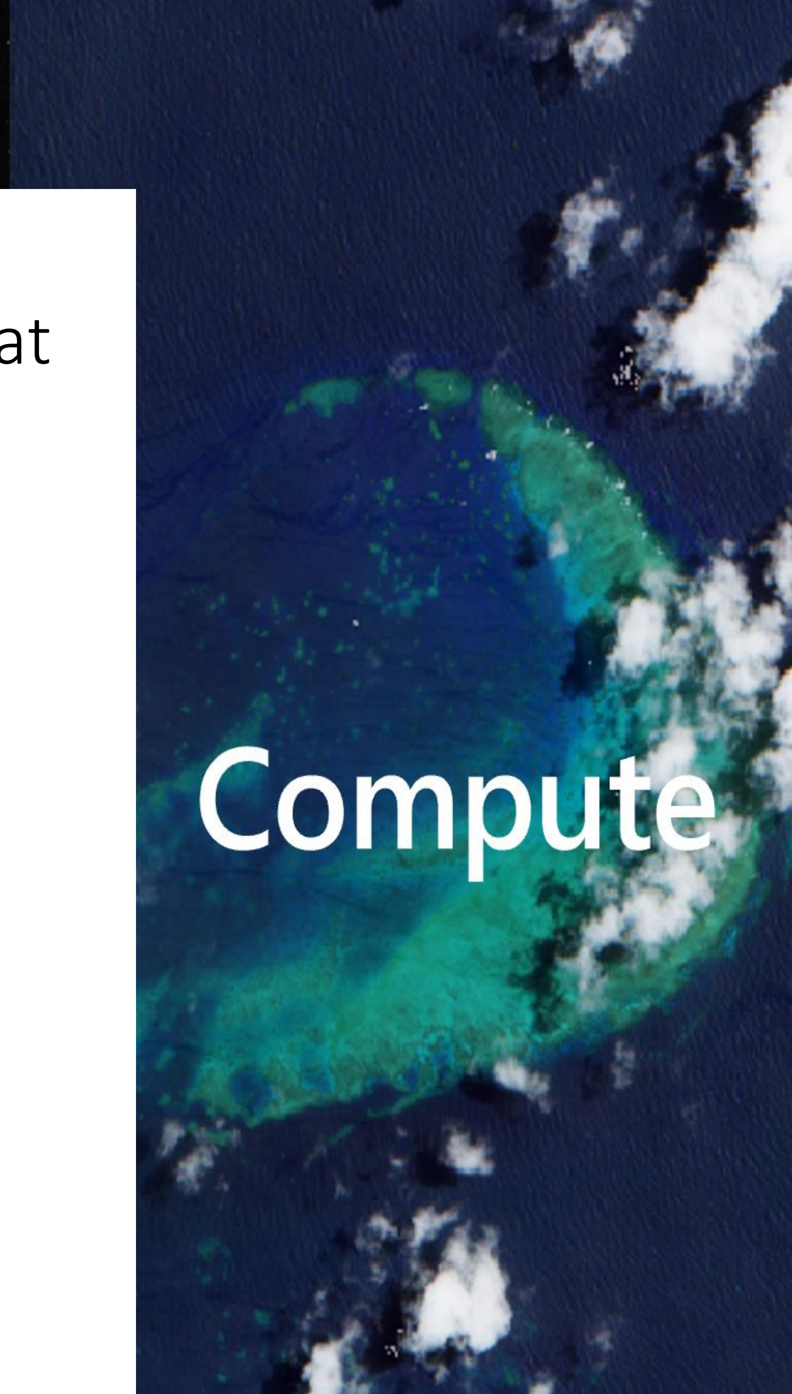

Demonstrating the Planetary Computer at the MTC

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MTC Sydney

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Microsoft Technology Centre

Experience the Microsoft Cloud

1 CONTENTS

2 INTRODUCTION

This document is meant to help you demonstrate the Planetary Computer in a locally relevant way
In this example, we will use the planetary computer to build the latest satellite imagery over the Great Barrier Reef in Australia.

There is significant attention on the sustainability of the Great Barrier Reef, which has in the recent years seen advanced levels of bleaching episodes occur through oceans warming to a greater extent due to climatic change.

Given that the Great Barrier Reef extends over 344 hundred thousand square kilometres, and 14 degrees of latitude , it is extremely difficult to effectively monitor solely from the ground. However a combination of satellite imagery and ground truths can help begin to solve these problems. But Satellite Imagery analysis has its own high barrier of entry. Until now. With the planetary computer, an initiative under Microsoft's sustainability umbrella.

In order to get a good view of the entire reef, we need to first find the individual images from the Sentinel-2 satellite. There is a new image captured every 5 days, so it's not just one image of a location, its a series of images of that particular slice, taken over several years.

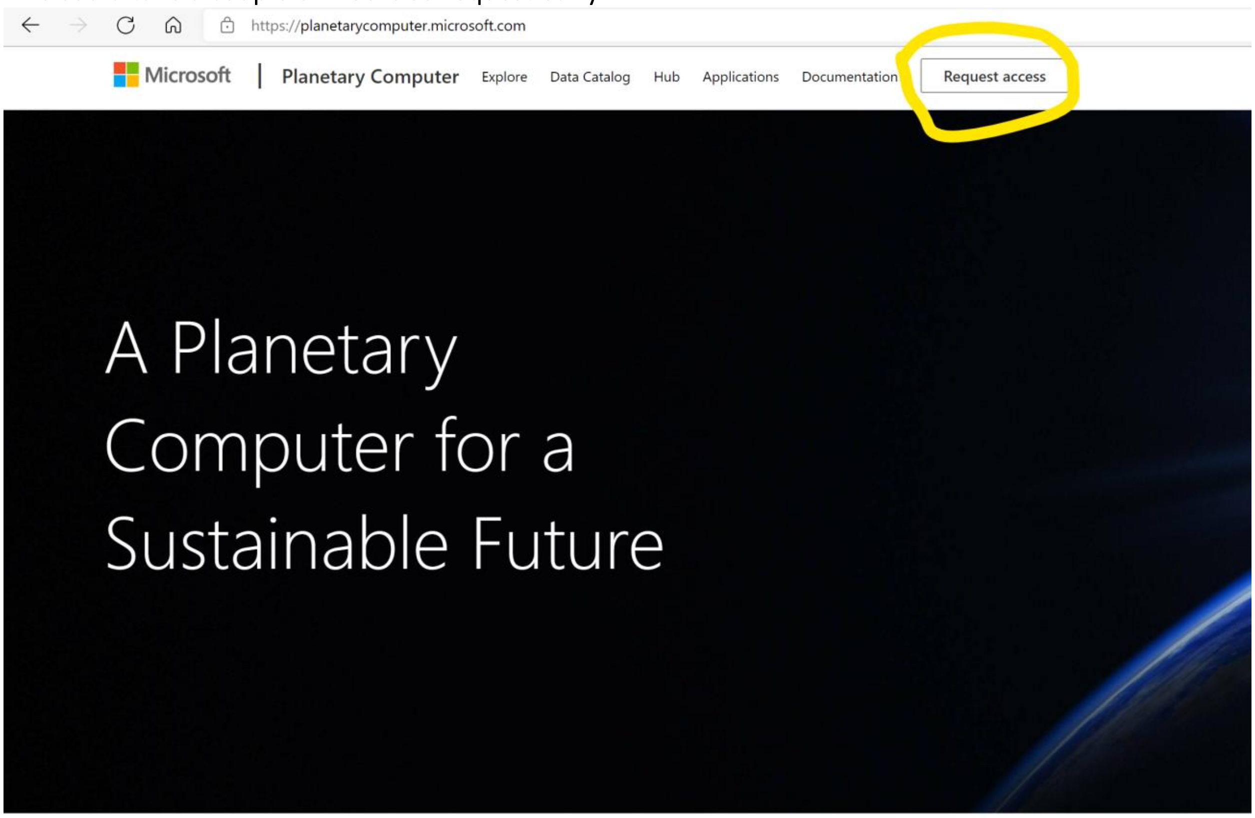
So which images should we choose? Well the clearest ones of course! And how we find those? Well, we choose those where we can see most of the ground. But wait, don’t clouds obstruct the view of the ground in satellite images? Yes, but clouds also move in relation to the ground. So we need to find enough images so that we can derive a view of the ground. Like calculating an average, but for an image.

So millions of pixels in a slice, thousands of slices of a specific region, and each slice taken afresh every 5 days over many years. This is going to need some significant oomph from a compute perspective. This demo creates this view in a few minutes using our Planetary Computer.

So we need to find a place that stores up-to-date satellite imagery, this storage also has to have a mechanism to lets us search through these images, and then give us a way to work with our selection of images, preferably from a fishing boat out near the reef (so just a tiny laptop) but use the near infinite scale of cloud resources.

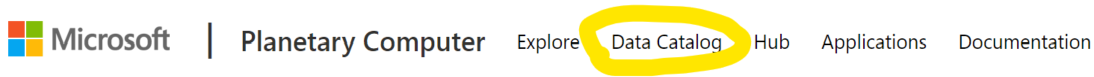
3 PRE-REQUISITES

First, request access on the planetary computer site. Home | Planetary Computer (microsoft.com) This could take a couple of weeks so request early.

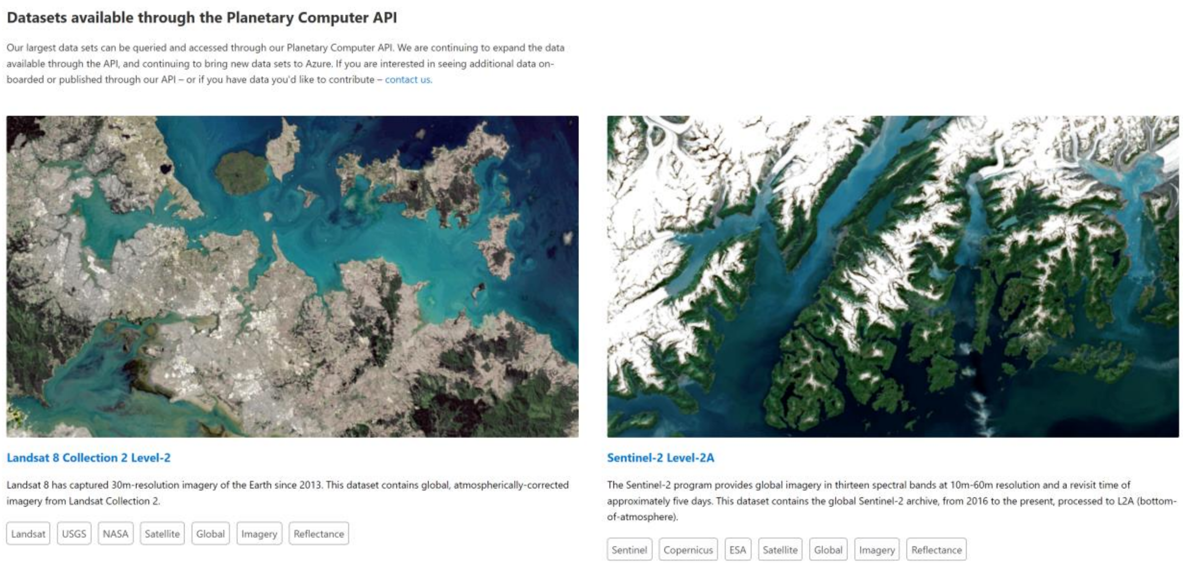


The code used in this demonstration is based on the sample cloudless mosaic sentinel2 tutorial. The code can be found at planetarycomputerdemos/cloudless-mosaic-sentinel2.ipynb at main · aslibass/planetarycomputerdemos (github.com)

4 DEMONSTRATE THE DATA CATALOG



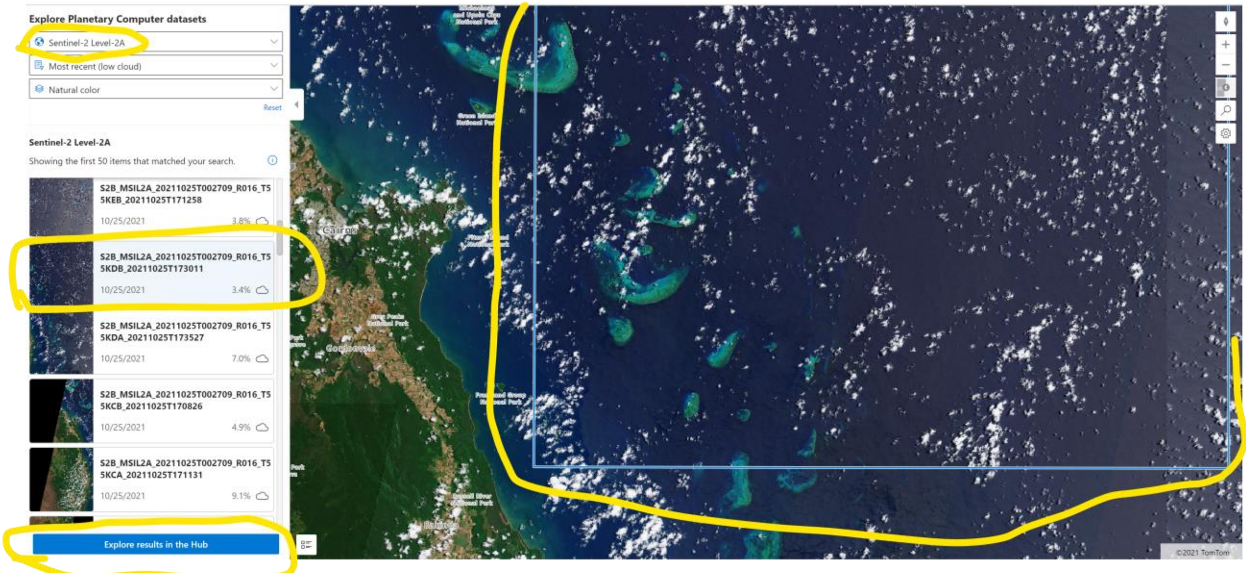
Open the Data Catalogue. Scroll through the various offerings. Filter for "global" and then stop and describe Sentinel-2. Look this up if you need more speaking points.



Note: The datasets under “additional” are ones that do not yet have an API and cannot be searched like the ones with the API…yet.

5 DEMONSTRATE THE EXPLORER

Open the Explorer. Select Sentinel-2. Then zoom into your area of interest. We look for the reef in this example. Move the mouse over the slices on the left and see how different parts of the map highlight to show where the slice fits, and that the slices are not all perfect squares but a range of shapes.



Once you've satisfied with your area of interest, then click the Explore in Hub button, and just copy the polygon co-ordinates it gives you.

Explore results

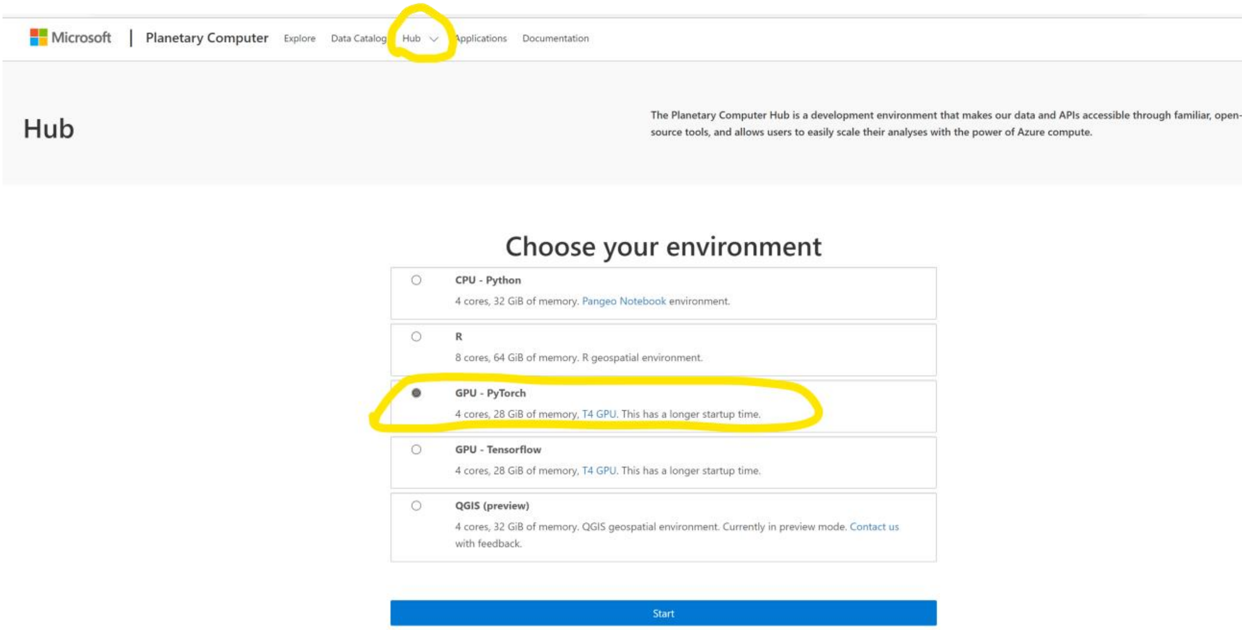
Use the code below to recreate this search in the Planetary Computer Hub or other Python analytic environments.

Copy Launch Hub

```
from pystac_client import Client
import planetary_computer as pc

# Search against the Planetary Computer STAC API
catalog = Client.open(
  "https://planetarycomputer.microsoft.com/api/stac/v1"
)
search = catalog.search(limit=50, filter={
  "and": [
    {"eq": [{"property": "collection"}, "sentinel-2-l2a"]},
    {
      "intersects": [
        {"property": "geometry"},
        {
          "type": "Polygon",
          "coordinates": [
            [
              [145.69632199606826, -17.405387688756164],
              [147.11215083401777, -17.405387688756164],
              [147.11215083401777, -16.615627160959093],
              [145.69632199606826, -16.615627160959093],
              [145.69632199606826, -17.405387688756164]
            ]
          ]
        }
      ]
    },
    {"lte": [{"property": "eo:cloud_cover"}, 10]}
  ]
})

# Grab the first item from the search results
first_item = next(search.get_items())

# Sign it and view the assets it contains
pc.sign_item(first_item).assets
```

6 Demonstrate the Hub

Step 3: Start the Hub
Sign into the hub, and choose the GPU based Python Pytorch notebook experience.



Navigate to the cloudless-mosaic-sentinel2 notebook in the tutorials section of the navigation pane.

7 Make Changes and Run the notebook

Run the first couple of cells to setup your environment and distributed cluster.

For a greater visual impact, start the following dask elements - Task Stream, Cluster Map and Progress. You can do this after clicking on the “Dask” view. Then rearrange these new tabs so you can see all of them along with your notebook.

Replace the co-ordinates you've copied from the previous steps in the cell with the area of interest variable.

Change the datetime to a more recent range like : datetime="2021-01-01/2021-11-11"
This makes the search time frame so that it's a the most recent year and up to your current date. If you subtract 5 days and re-run the cell, you'll see one less image, proving that there was an update in the last 5 days.

Add a couple of cells to print out the different kinds of information embedded in the image.

```
selected_item = sorted(items, key=lambda item:
item.properties["eo:cloud_cover"])[20]

for asset_key, asset in selected_item.assets.items():

print(f"{asset_key:<25} - {asset.title}")
```

```
selected_item = sorted(items, key=lambda item: item.properties["eo:cloud_cover"])[20]
```

```
for asset_key, asset in selected_item.assets.items():
    print(f"{asset_key:<25} - {asset.title}")
```

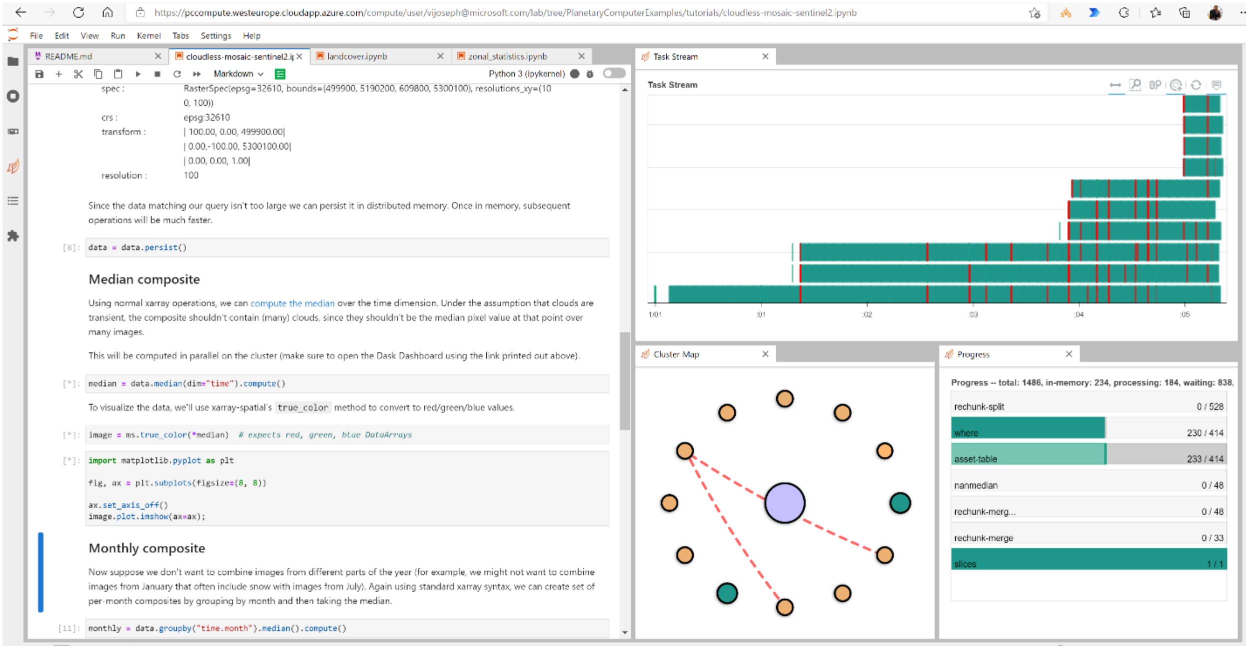
```
AOT                       - Aerosol optical thickness (AOT)
B01                       - Band 1 - Coastal aerosol - 60m
B02                       - Band 2 - Blue - 10m
B03                       - Band 3 - Green - 10m
B04                       - Band 4 - Red - 10m
B05                       - Band 5 - Vegetation red edge 1 - 20m
B06                       - Band 6 - Vegetation red edge 2 - 20m
B07                       - Band 7 - Vegetation red edge 3 - 20m
B08                       - Band 8 - NIR - 10m
B09                       - Band 9 - Water vapor - 60m
B11                       - Band 11 - SWIR (1.6) - 20m
B12                       - Band 12 - SWIR (2.2) - 20m
B8A                       - Band 8A - Vegetation red edge 4 - 20m
SCL                       - Scene classfication map (SCL)
WVP                       - Water vapour (WVP)
visual                    - True color image
preview                   - Thumbnail
safe-manifest             - SAFE manifest
granule-metadata          - Granule metadata
inspire-metadata          - INSPIRE metadata
product-metadata          - Product metadata
datastrip-metadata        - Datastrip metadata
tilejson                  - TileJSON with default rendering
rendered_preview          - Rendered preview
```

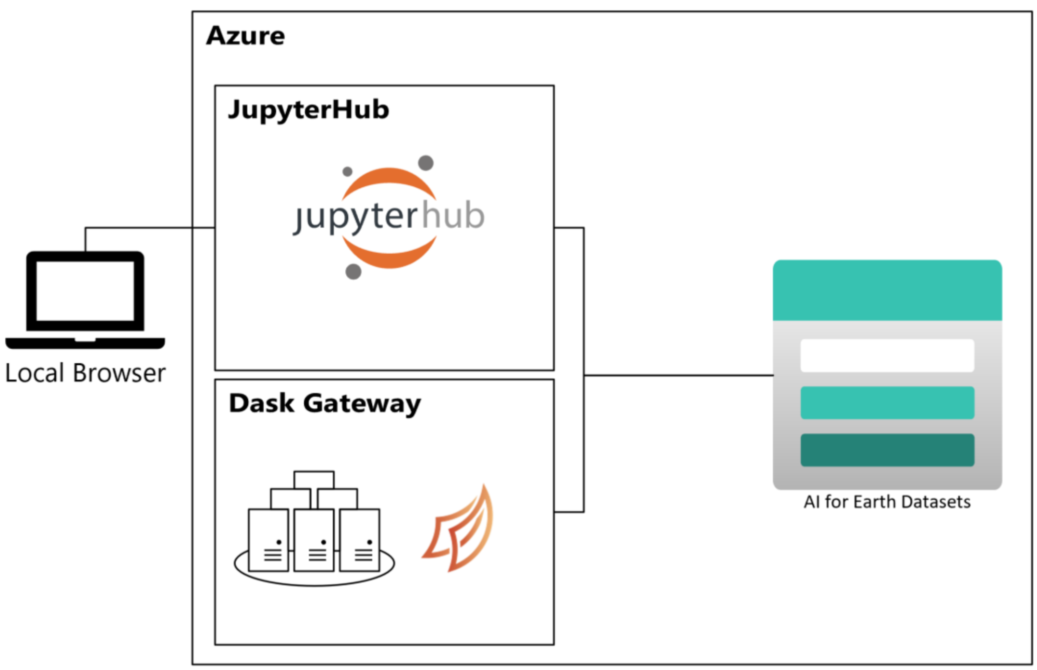
Show a thumbnail of one example that you’re working with
Add lines to get any one to show as a thumbnail

```python
import json
import requests

thumbnail_asset = selected_item.assets["preview"]
signed_href = planetary_computer.sign(thumbnail_asset.href)
```

```python
from PIL import Image
from urllib.request import urlopen

Image.open(urlopen(signed_href))
```

Describe Dask and the planetary hub architecture and use the Cluster Map other tabs to show how the cluster is being scaled up, how data is moving between the different nodes, and the GPU based VM's being used while you wait for the processing to complete. Very meditative to watch. :-D





At the end, you should have a cloud free composite image of your area of interest.
Point out that what you've just done in a few minutes would a few years ago cost a (very) pretty penny, and taken several months of work to get to.

8 Theoretical - Detecting Coral Bleaching Events

So how does this help solve the bleaching problem? Current research shows that using radiometric normalization using Pseudo Invariant Features across a time series can show where and when bleaching occurred. (Say what? You measure the pixel values, there's a range of them in a satellite image - like Near Infra Red, Short Wave Infra Red, Blue, Green etc. You normalize by setting the range to be between pixels in deep ocean, and the bright pixels on sand. You then you reference pixels where things are not real and dont generally change like roads and hills and the sort. You then create a time series of these new values for that particular area over a period of time. Where-ever the time series shows an increase in the pixel value followed by a decrease in a short period could indicate a potential bleaching event. These locations then need to checked by local experts. While there may be false positives, there is also a significant reduction in potential sites to search based on this technique.)