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E/20/425

EXPLORING SENTINEL 2 DATASET

VISUALIZE THE TRUE COLOUR IMAGE

```python
# Mount Google Drive
from google.colab import drive
drive.mount('/content/drive')

import os
import rasterio
import numpy as np
import matplotlib.pyplot as plt

# Base path to Google Drive
base_path = '/content/drive/MyDrive'

# OPTIONAL: View folders in Drive
print("Root folders in Drive:", os.listdir(base_path))

# Define path to Sentinel-2 data folder
data_path = os.path.join(base_path,
"test/S2B_MSIL2A_20250501T050609_N0511_R076_T44NNN_20250501T070700.SAFE/S2
B_MSIL2A_20250501T050609_N0511_R076_T44NNN_20250501T070700.SAFE")

# Navigate to the IMG_DATA/R10m folder
granule_dir = os.path.join(data_path, "GRANULE")
granule_subdir = os.listdir(granule_dir)[0]
img_data_dir = os.path.join(granule_dir, granule_subdir, "IMG_DATA")
r10m_dir = os.path.join(img_data_dir, "R10m")

# Check available band files
print("R10m Band files:", os.listdir(r10m_dir))

# Define paths to RGB bands
band_paths = {
    'B04': os.path.join(r10m_dir, [f for f in os.listdir(r10m_dir) if
'B04_10m' in f][0]),  # Red
    'B03': os.path.join(r10m_dir, [f for f in os.listdir(r10m_dir) if
'B03_10m' in f][0]),  # Green
    'B02': os.path.join(r10m_dir, [f for f in os.listdir(r10m_dir) if
'B02_10m' in f][0]),  # Blue
}
```

```python
# Read each band using rasterio
with rasterio.open(band_paths['B04']) as red_src:
    red = red_src.read(1).astype('float32')

with rasterio.open(band_paths['B03']) as green_src:
    green = green_src.read(1).astype('float32')

with rasterio.open(band_paths['B02']) as blue_src:
    blue = blue_src.read(1).astype('float32')

# Stack into RGB and normalize for display
rgb = np.dstack((red, green, blue))
rgb_min = np.percentile(rgb, 2)
rgb_max = np.percentile(rgb, 98)
rgb = np.clip((rgb - rgb_min) / (rgb_max - rgb_min), 0, 1)

# Display image
plt.figure(figsize=(10, 10))
plt.imshow(rgb)
plt.title("Sentinel-2 True Color Image (B04, B03, B02)")
plt.axis('off')
plt.show()
```
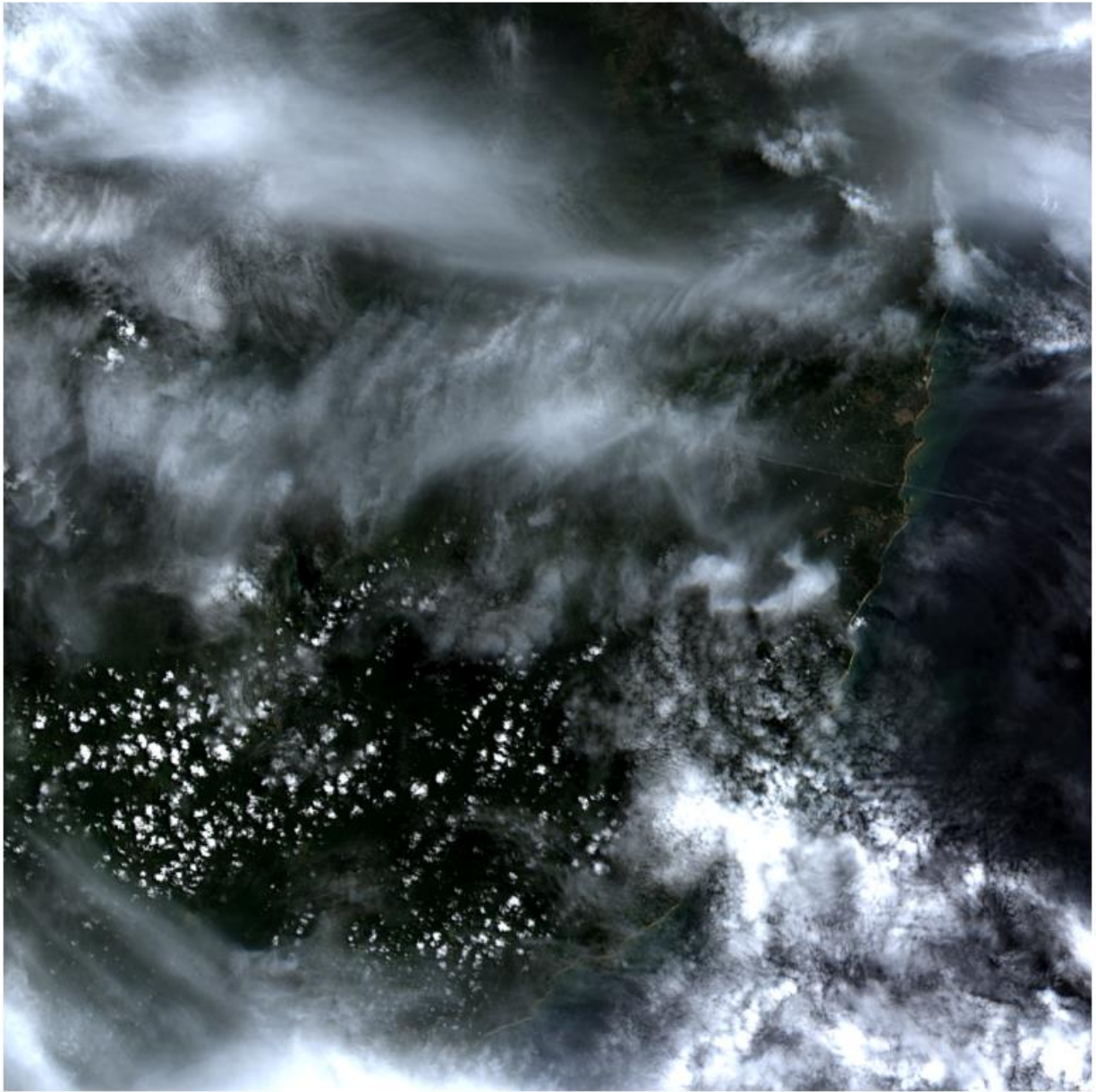
Sentinel-2 True Color Image (B04, B03, B02)

VISUALIZE EACH BANDS

```python
#Mount Google Drive
from google.colab import drive
drive.mount('/content/drive')

#Import required libraries
import os
import rasterio
import numpy as np
import matplotlib.pyplot as plt

#Set the correct path to your R10m folder
data_path =
"/content/drive/MyDrive/test/S2B_MSIL2A_20250501T050609_N0511_R076_T44NNN_
20250501T070700.SAFE/S2B_MSIL2A_20250501T050609_N0511_R076_T44NNN_20250501
T070700.SAFE"
granule_dir = os.path.join(data_path, "GRANULE")
granule_subdir = os.listdir(granule_dir)[0]
r10m_dir = os.path.join(granule_dir, granule_subdir, "IMG_DATA", "R10m")

#Define band file paths (Red, Green, Blue)
band_paths = {
    'B04': os.path.join(r10m_dir,
'T44NNN_20250501T050609_B04_10m.jp2'),   # Red
    'B03': os.path.join(r10m_dir,
'T44NNN_20250501T050609_B03_10m.jp2'),   # Green
    'B02': os.path.join(r10m_dir,
'T44NNN_20250501T050609_B02_10m.jp2'),   # Blue
}

#Load bands into a dictionary
bands = {}
for b in band_paths:
    with rasterio.open(band_paths[b]) as src:
        bands[b] = src.read(1).astype(np.float32)

#Normalize for visualization
def normalize(array):
    return (array - array.min()) / (array.max() - array.min())

#Plot each band individually
fig, axs = plt.subplots(1, 3, figsize=(18, 6))

axs[0].imshow(normalize(bands['B04']), cmap='gray')
```
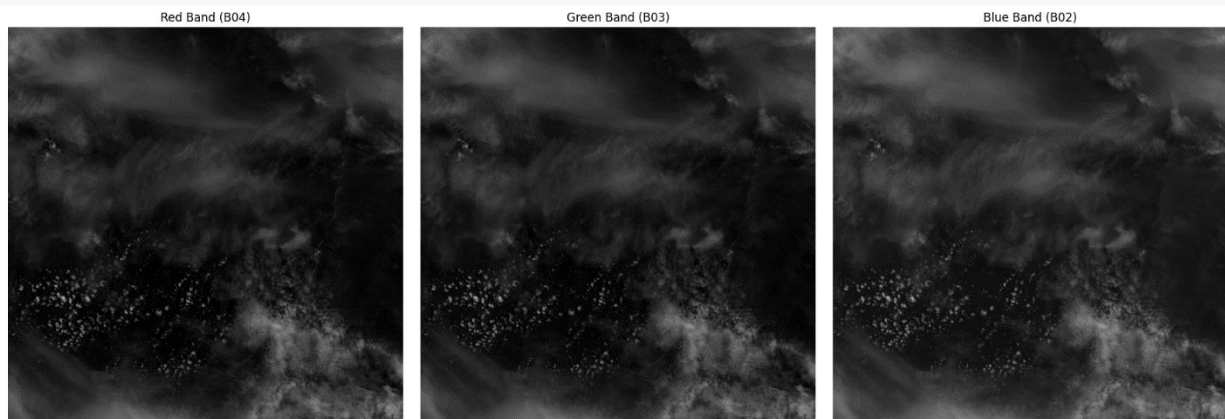
```
axs[0].set_title('Red Band (B04)')
axs[0].axis('off')

axs[1].imshow(normalize(bands['B03']), cmap='gray')
axs[1].set_title('Green Band (B03)')
axs[1].axis('off')

axs[2].imshow(normalize(bands['B02']), cmap='gray')
axs[2].set_title('Blue Band (B02)')
axs[2].axis('off')

plt.tight_layout()
plt.show()
```


Red Band (B04) Green Band (B03) Blue Band (B02)

Normalized Difference Vegetation Index

$$\text{NDVI} = \frac{B08 - B04}{B08 + B04}$$

```
# Mount Google Drive
from google.colab import drive
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#Import libraries
import os
import rasterio
import numpy as np
import matplotlib.pyplot as plt
```

```python
#Set the correct path to the R10m directory
data_path =
"/content/drive/MyDrive/test/S2B_MSIL2A_20250501T050609_N0511_R076_T44NNN_
20250501T070700.SAFE/S2B_MSIL2A_20250501T050609_N0511_R076_T44NNN_20250501
T070700.SAFE"
granule_dir = os.path.join(data_path, "GRANULE")
granule_subdir = os.listdir(granule_dir)[0]
r10m_dir = os.path.join(granule_dir, granule_subdir, "IMG_DATA", "R10m")

#Define file paths for Red (B04) and NIR (B08)
band_paths = {
    'B04': os.path.join(r10m_dir,
'T44NNN_20250501T050609_B04_10m.jp2'),  # Red
    'B08': os.path.join(r10m_dir,
'T44NNN_20250501T050609_B08_10m.jp2')   # NIR
}

#Read the bands using rasterio
with rasterio.open(band_paths['B04']) as red_src:
    red = red_src.read(1).astype(np.float32)

with rasterio.open(band_paths['B08']) as nir_src:
    nir = nir_src.read(1).astype(np.float32)

#Calculate NDVI = (NIR - Red) / (NIR + Red)
ndvi_numerator = nir - red
ndvi_denominator = nir + red
ndvi_denominator[ndvi_denominator == 0] = 0.01  # Avoid division by zero
ndvi = ndvi_numerator / ndvi_denominator

#Clip values to range -1 to 1 for visualization
ndvi = np.clip(ndvi, -1, 1)

#Plot the NDVI image
plt.figure(figsize=(10, 10))
ndvi_plot = plt.imshow(ndvi, cmap='RdYlGn', vmin=-1, vmax=1)
plt.colorbar(ndvi_plot, shrink=0.7, label='NDVI')
plt.title("NDVI (Vegetation Index) from Sentinel-2")
plt.axis('off')
plt.show()
```

NDVI (Vegetation Index) from Sentinel-2