

exercise_03_downloading_data

August 13, 2021

1 Exercise 03 - opening an online dataset

1.1 NASA ocean color data

This problem demonstrates how we can access Ocean Color data from NASA.

The main repository for NASAs ocean color data is: <https://oceandata.sci.gsfc.nasa.gov/opensap/>

We will look at data from the MODIS-Aqua (MODIS-A) satellite, and in particular we will look at the level 3 product, which is data that has gone through the highest level of processing and nicely gridded.

NASA organizes data by year and year day. You can see this structure by clicking through the OpenDAP server. The file used in this example contains the mapped chlorophyll-a data for July 28 (year day 210), 2019.

```
[1]: import xarray as xr
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
```

2 Use `xr.open_dataset()` to access the data

The data for yearday 210 of 2019 is located at:

`url = 'https://oceandata.sci.gsfc.nasa.gov:443/opensap/MODISA/L3SMI/2019/210/A2019210.L3m_DAY_CHL_chlor_a_4km.nc'`

```
[2]: url = 'https://oceandata.sci.gsfc.nasa.gov:443/opensap/MODISA/L3SMI/2019/210/
      ↪A2019210.L3m_DAY_CHL_chlor_a_4km.nc'
data = xr.open_dataset(url)

data
```

```
[2]: <xarray.Dataset>
Dimensions: (lat: 4320, lon: 8640, rgb: 3, eightbitcolor: 256)
Coordinates:
  * lat      (lat) float32 89.98 89.94 89.9 89.85 ... -89.85 -89.9 -89.94 -89.98
  * lon      (lon) float32 -180.0 -179.9 -179.9 -179.9 ... 179.9 179.9 180.0
Dimensions without coordinates: rgb, eightbitcolor
Data variables:
```

```

    palette (rgb, eightbitcolor) int8 ...
    chlor_a (lat, lon) float32 ...
Attributes: (12/64)
  _NCProperties:          version=1|netcdflibversion=4.4.1.1|hdf...
  product_name:         A2019210.L3m_DAY_CHL_chlor_a_4km.nc
  instrument:           MODIS
  title:                MODISA Level-3 Standard Mapped Image
  project:              Ocean Biology Processing Group (NASA/G...
  platform:             Aqua
  ...
  identifier_product_doi: 10.5067/AQUA/MODIS/L3M/CHL/2018
  keywords:             Earth Science > Oceans > Ocean Chemist...
  keywords_vocabulary:  NASA Global Change Master Directory (G...
  data_bins:            Attribute edlided: Unsupported attribu...
  data_minimum:         0.008464555
  data_maximum:         99.794235

```

3 Subset the data

let's just grab the mid-atlantic bight.

Note, that for some reason I don't understand, the `lat` coords are listed from high to low, so when you slice, you need to reverse the order, i.e. use `sel(lat=slice(41, 38))` *not* `sel(lat=slice(38, 41))`. This is a mystery.

fill in the blanks to get a subset of the data that covers the MAB (the lat boundaries at 38 to 41 degrees, and lon boundaries are -76 to -71):

```
data_mab_nj = data.__( lat = __, lon = __)
```

```
[3]: data_mab_nj = data.sel( lat=slice(41, 38), lon=slice(-76,-71))

data_mab_nj
```

```
[3]: <xarray.Dataset>
Dimensions: (lat: 72, lon: 120, rgb: 3, eightbitcolor: 256)
Coordinates:
  * lat      (lat) float32 40.98 40.94 40.9 40.85 ... 38.15 38.1 38.06 38.02
  * lon      (lon) float32 -75.98 -75.94 -75.9 -75.85 ... -71.1 -71.06 -71.02
Dimensions without coordinates: rgb, eightbitcolor
Data variables:
    palette (rgb, eightbitcolor) int8 -109 0 108 -112 0 111 ... 105 0 0 0 0 0
    chlor_a (lat, lon) float32 ...
Attributes: (12/64)
  _NCProperties:          version=1|netcdflibversion=4.4.1.1|hdf...
  product_name:         A2019210.L3m_DAY_CHL_chlor_a_4km.nc
  instrument:           MODIS
  title:                MODISA Level-3 Standard Mapped Image

```

```

project: Ocean Biology Processing Group (NASA/G...
platform: Aqua
...
identifier_product_doi: 10.5067/AQUA/MODIS/L3M/CHL/2018
keywords: Earth Science > Oceans > Ocean Chemist...
keywords_vocabulary: NASA Global Change Master Directory (G...
data_bins: Attribute edlided: Unsupported attribu...
data_minimum: 0.008464555
data_maximum: 99.794235

```

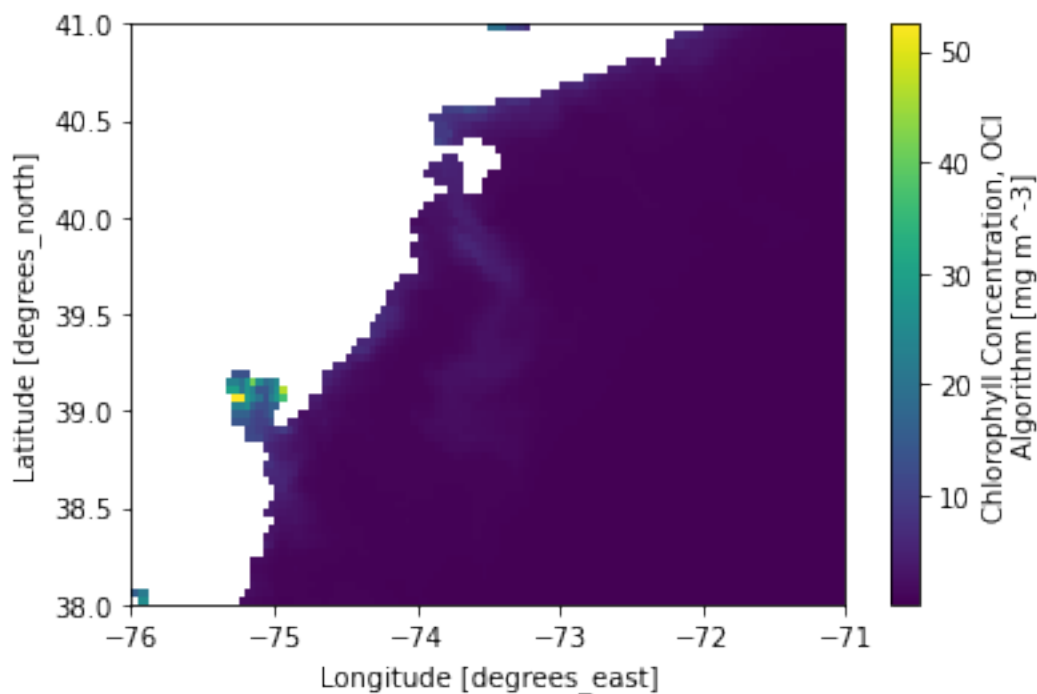
4 plot the chlorophyll a

for the mid atlantic bight subset using the built-in xarray plotting routine. i.e. fill in the blanks, and remember we want to just plot the variable `chlor_a`:

```
data_mab_nj.____.____()
```

```
[4]: data_mab_nj.chlor_a.plot()
```

```
[4]: <matplotlib.collections.QuadMesh at 0x7fc111e98df0>
```



5 Chla should be plotted on a log scale

Let's make the same plot with matplotlib, and use `np.log10()` to plot the data on a log scale:

```
plt.pcolormesh( data_mab_nj.____, data_mab_nj.____, np.log10(data_mab_nj.____))
# add a colorbar
```

be sure to label all your axes

```
[6]: plt.pcolormesh(data_mab_nj.lon, data_mab_nj.lat, np.log10(data_mab_nj.chlor_a))
      cb = plt.colorbar()

      plt.xlabel("Longitude")
      plt.ylabel("Latitude")

      cb.set_label("log 10 Chla")
```

<ipython-input-6-fa4ab49652d0>:1: MatplotlibDeprecationWarning: shading='flat' when X and Y have the same dimensions as C is deprecated since 3.3. Either specify the corners of the quadrilaterals with X and Y, or pass shading='auto', 'nearest' or 'gouraud', or set rcParams['pcolor.shading']. This will become an error two minor releases later.

```
plt.pcolormesh(data_mab_nj.lon, data_mab_nj.lat,
np.log10(data_mab_nj.chlor_a))
```

