L09-18-11-7-P2-mapmaking

November 12, 2018

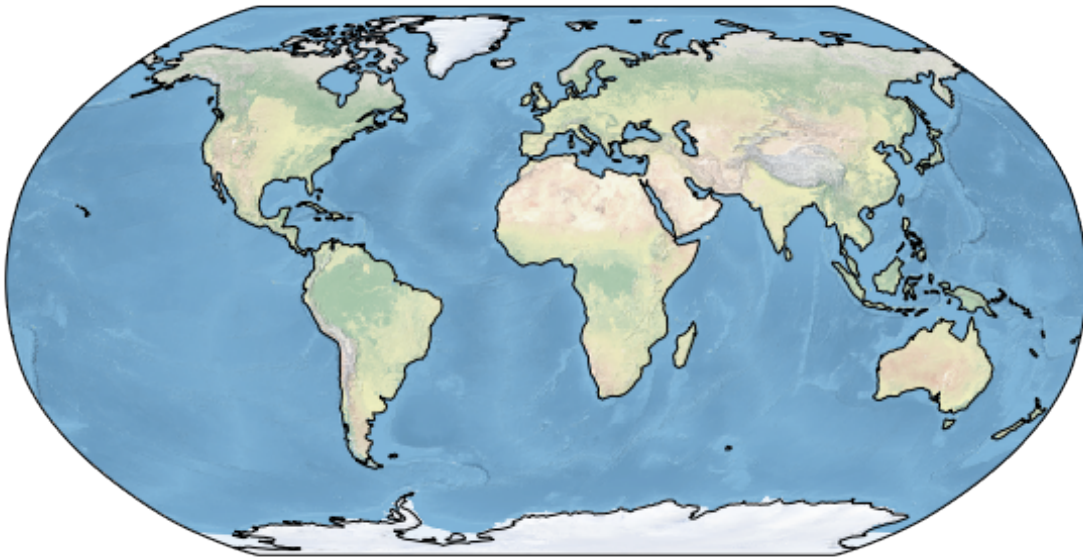## 1 (A) how to make a static map

```
In [2]: import matplotlib.pyplot as plt
        import cartopy.crs as ccrs
        %matplotlib inline

In [3]: fig = plt.figure(figsize=(10, 5))
        ax = fig.add_subplot(1, 1, 1, projection=ccrs.Robinson())

        # make the map global rather than have it zoom in to
        # the extents of any plotted data
        ax.set_global()

        ax.stock_img()
        ax.coastlines()

        plt.show()
```
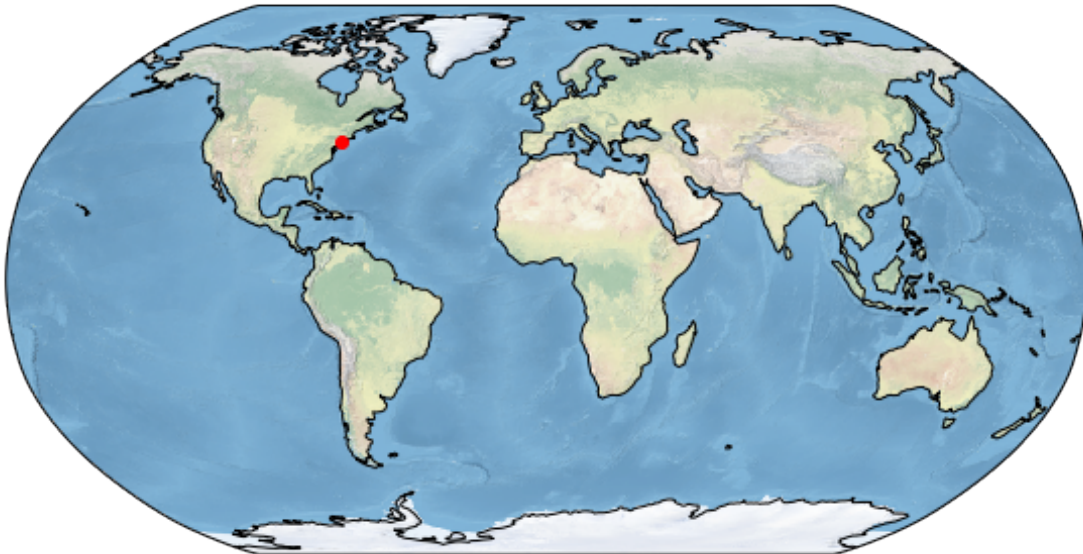
2 (B) How to put points, lines and polygons (shape data) on the map

```
In [4]: fig = plt.figure(figsize=(10, 5))
        ax = fig.add_subplot(1, 1, 1, projection=ccrs.Robinson())

        # make the map global rather than have it zoom in to
        # the extents of any plotted data
        ax.set_global()

        ax.stock_img()
        ax.coastlines()
        #40.7128ř N, 74.0060ř W
        ax.plot(360 -74.0060, 40.7128, 'o', color='R', transform=ccrs.PlateCarree())
        plt.show()
```



```
In [5]: fig = plt.figure(figsize=(10, 5))
        ax = fig.add_subplot(1, 1, 1, projection=ccrs.Robinson())

        # make the map global rather than have it zoom in to
        # the extents of any plotted data
        ax.stock_img()
        ax.coastlines()
        #40.7128ř N, 74.0060ř W
        #34.0522ř N, 118.2437ř W
        ax.plot(360 -74.0060, 40.7128, 'o', color='R', transform=ccrs.PlateCarree())
        ax.plot(360 -118.2437,34.0522 , 'o', color='R', transform=ccrs.PlateCarree())
        ax.plot([ 360-118.2437, 360-74.0060], [34.0522, 40.7128], transform=ccrs.Geodetic(), co
        plt.show()
```
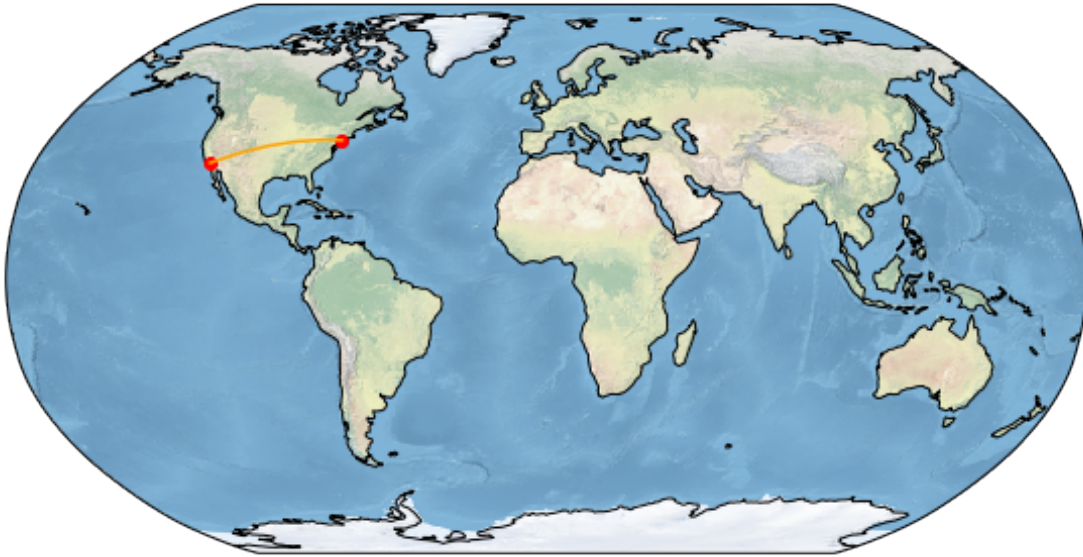
```
In [6]: import cartopy.io.shapereader as shpreader

        # can also be a shape file
        shpfilename = shpreader.natural_earth(resolution='110m',
                                              category='cultural',
                                              name='admin_0_countries')

In [7]: reader = shpreader.Reader(shpfilename)
        countries = reader.records()
        country = next(countries)

In [8]: country

Out[8]: <Record: <shapely.geometry.multipolygon.MultiPolygon object at 0x7f7bd8bbeef0>, {'featu

In [9]: country.attributes.keys()

Out[9]: dict_keys(['featurecla', 'scalerank', 'LABELRANK', 'SOVEREIGNT', 'SOV_A3', 'ADM0_DIF',

In [10]: country.attributes['INCOME_GRP']

Out[10]: '4. Lower middle income'

In [11]: import matplotlib.cm as mcm

         fig = plt.figure(figsize=(10, 5))
         ax = fig.add_subplot(1, 1, 1, projection=ccrs.Robinson())

         # make the map global rather than have it zoom in to
```
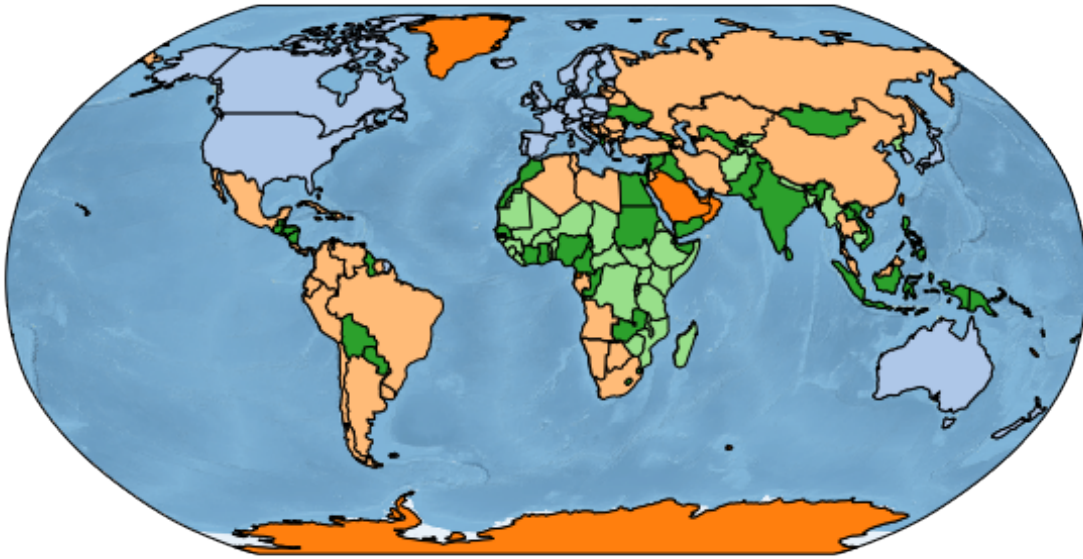
```
    # the extents of any plotted data
    ax.stock_img()
    ax.coastlines()
    #40.7128r N, 74.0060r W
    #34.0522r N, 118.2437r W
    for cgeo, crec in zip(reader.geometries(), reader.records()):
        inc_code = int(crec.attributes['INCOME_GRP'].split('.')[0])
        fc = mcm.tab20(inc_code)
        ax.add_geometries([cgeo], ccrs.PlateCarree(), edgecolor='k', facecolor=fc)
    plt.show()
```


3 (C) How to put an image on (under) a map … could be a heatmap or sat image

```
In [23]: import xarray as xr
```

```
In [25]: ds = xr.tutorial.load_dataset('air_temperature')
         ds
```

```
Out[25]: <xarray.Dataset>
         Dimensions:  (lat: 25, lon: 53, time: 2920)
         Coordinates:
           * lat      (lat) float32 75.0 72.5 70.0 67.5 65.0 ... 25.0 22.5 20.0 17.5 15.0
           * lon      (lon) float32 200.0 202.5 205.0 207.5 ... 322.5 325.0 327.5 330.0
           * time     (time) datetime64[ns] 2013-01-01 ... 2014-12-31T18:00:00
         Data variables:
             air      (time, lat, lon) float32 241.2 242.5 243.5 ... 296.49 296.19 295.69
```
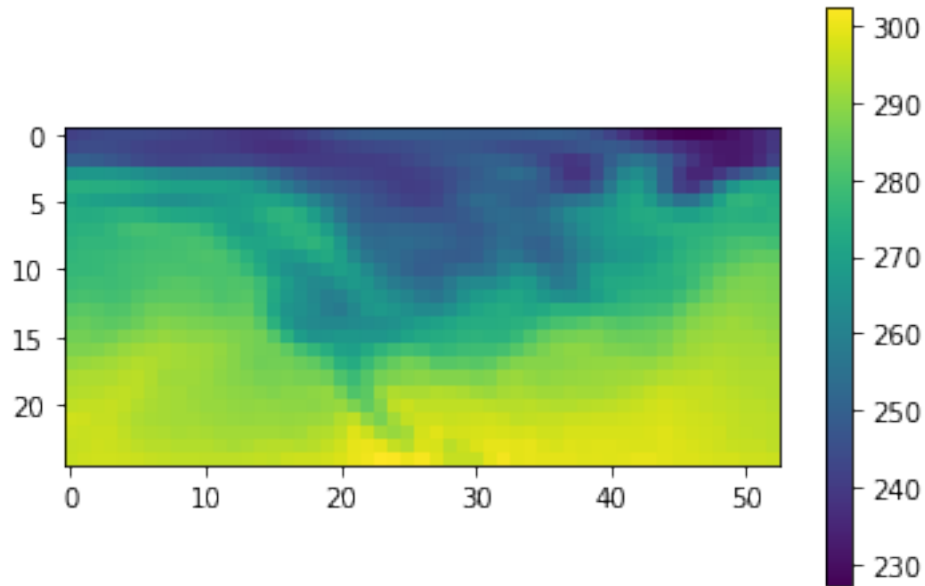
4

```
Attributes:
    Conventions:  COARDS
    title:        4x daily NMC reanalysis (1948)
    description:  Data is from NMC initialized reanalysis\n(4x/day).  These a...
    platform:     Model
    references:   http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanaly...
```
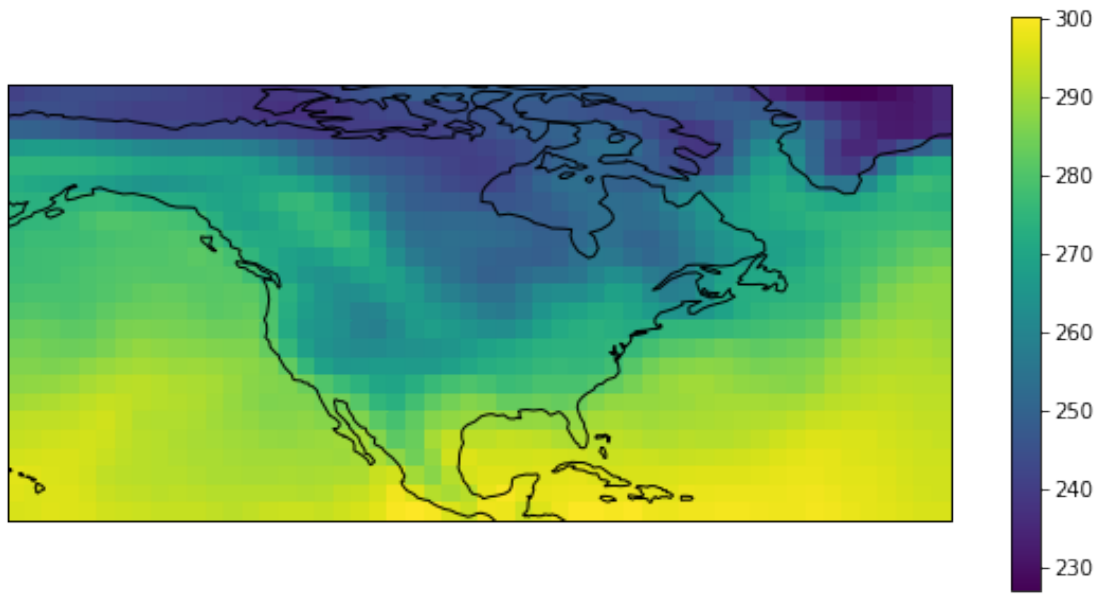
In [30]: `im = plt.imshow(ds['air'][0])`
`_ = plt.colorbar(im)`

In [64]: `# let's map`

```
fig = plt.figure(figsize=(10, 5))
ax = fig.add_subplot(1, 1, 1, projection=ccrs.PlateCarree())

# make the map global rather than have it zoom in to
# the extents of any plotted data

im = ax.pcolor(ds['lon'].values, ds['lat'].values, ds['air'][0].values,
               transform=ccrs.PlateCarree())
ax.coastlines()
fig.colorbar(im, ax=ax)
plt.show()
```

```
In [73]: ds['air'][0].plot()
```

```
Out[73]: <matplotlib.collections.QuadMesh at 0x7f7ba9569c88>
```