

第四次作业

第一题 Global Earthquakes

题目叙述: In this problem set, we will use this file from the USGS Earthquakes Database. The dataset is similar to the one you use in Assignment 02. Use the file provided (usgs_earthquakes.csv) to recreate the following map. Use the mag column for magnitude.

(按照之前课上讲的绘制地图步骤, 进行还原原图)

首先各种初始化,

```
In [15]: # Import modules
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import netCDF4 as nc
import xarray as xr
import datetime
import matplotlib.pyplot as plt
import matplotlib.ticker as mticker
%matplotlib inline
import cartopy.crs as ccrs
import cartopy.feature as cfeature
import matplotlib as mpl
```

然后按照之前课上各个模块语句的功能依次选择合适的语句添加其中, 来绘图

```
In [16]: # 第一问
Usgs_data = pd.read_csv('./usgs_earthquakes.csv')
df = Usgs_data.sort_values(by="mag", ascending=False)[0:50]

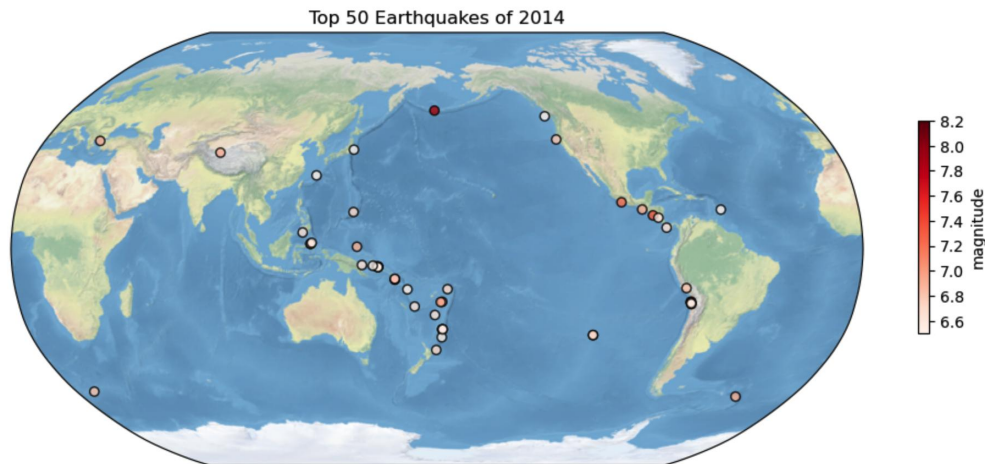
In [19]: # Create and define the size of a figure object
fig = plt.figure(figsize=(10,8), dpi=100)
# Create an axes with an Robinson projection style
proj = ccrs.Robinson(central_longitude=180)
ax = plt.axes(projection=proj)
ax.set_global()

# Add features to axes using cartopy.feature (cfeature)
ax.add_feature(cfeature.LAND)
# cm = plt.cm.get_cmap('hot')
ax.stock_img()
ax.scatter(df.longitude, df.latitude,
           edgecolors='k',
           c=df.mag, alpha=0.8, cmap = 'Reds',
           transform=ccrs.PlateCarree(), vmin=6.5, vmax=8.2,
           marker='o')

# add color into figure
pos = ax.get_position()
cax = fig.add_axes([pos.xmax+0.05, pos.ymin+0.15, 0.01, (pos.ymax-pos.ymin-0.25)])
cbar = mpl.colorbar.ColorbarBase(cax, norm=mpl.colors.Normalize(6.5, 8.2), ticks=list(np.linspace(6.6, 8.2, 9)), orientation='vertical', cmap=plt.cm.get_cmap('Reds'))
cbar.ax.set_ylabel('magnitude')
ax.set_title('Top 50 Earthquakes of 2014')

Out[19]: Text(0.5, 1.0, 'Top 50 Earthquakes of 2014')
```

最终画图结果如下, 完美复原



第二题 Explore a netCDF dataset

题目叙述 Browse the NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC) website. Search and download a dataset you are interested in. You are also welcome to use data from your group in this problem set. But the dataset should be in netCDF format. For this problem set, you are welcome to use the same dataset you used in Assignment 03.

一共分为两问

第一问：首先也是个初始化

```
In [53]: # 第二题 第一问
import numpy as np
import xarray as xr
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.ticker as mticker
%matplotlib inline
import cartopy.feature as cfeature
import cartopy.crs as ccrs
from cartopy.mpl.ticker import LongitudeFormatter, LatitudeFormatter
import matplotlib.pyplot as plt
from matplotlib.offsetbox import AnchoredText

ds = xr.open_dataset('air.sig007.2010.nc')
ds

/Users/zcjsustech/opt/anaconda3/envs/ese5023/lib/python3.9/site-packages/xarray/coding/times.py:123: Serialization
Warning: Ambiguous reference date string: 1-1-1 00:00:0.0. The first value is assumed to be the year hence will be
padded with zeros to remove the ambiguity (the padded reference date string is: 0001-1-1 00:00:0.0). To remove this
message, remove the ambiguity by padding your reference date strings with zeros.
warnings.warn(warning_msg, SerializationWarning)
```

```
Out [53]: xarray.Dataset

Dimensions:          (lat: 73, lon: 144, time: 366)

Coordinates:
  lat                (lat) float32  90.0 87.5 85.0 ... -87.5 -90.0
  lon                (lon) float32   0.0 2.5 5.0 ... 352.5 355.0 357.5
  time               (time) datetime64[ns] 2012-01-01 ... 2012-12-31

Data variables:
  air                (time, lat, lon) float32 ...
```

2.1 题目叙述[10 points] Make a global map of a certain variable. Your figure should contain: a project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box

每一点给一分

```

In [83]: #a project
plt.figure(figsize=(10,6),dpi=100)
ax = plt.axes(projection=ccrs.PlateCarree())
# marks and feature
ax.add_feature(cfeature.NaturalEarthFeature(category='cultural',
                                             name='admin_0_countries',
                                             scale='110m',
                                             facecolor='none',
                                             edgecolor='black',
                                             linewidth=0.2))

# plot figure and color
ds.air.mean('time').plot(transform=ccrs.PlateCarree(),zorder=0,cmap='Reds',vmin=150,vmax=340,add_colorbar=True,
                          cbar_kwargs={'shrink':0.8,'pad':0.03,'aspect':40,'label':'Air Temperature (K)'})

# add a title
ax.set_title("Global Ground Air Figure in 2010 ",fontsize=14)

# add gridlines
gl = ax.gridlines(ccrs=ccrs.PlateCarree(), linewidth=0.1, color='black', alpha=1)
gl.ylocator = mticker.FixedLocator(np.arange(-90,90,30))
gl.xlocator = mticker.FixedLocator(np.arange(-180, 180, 45))

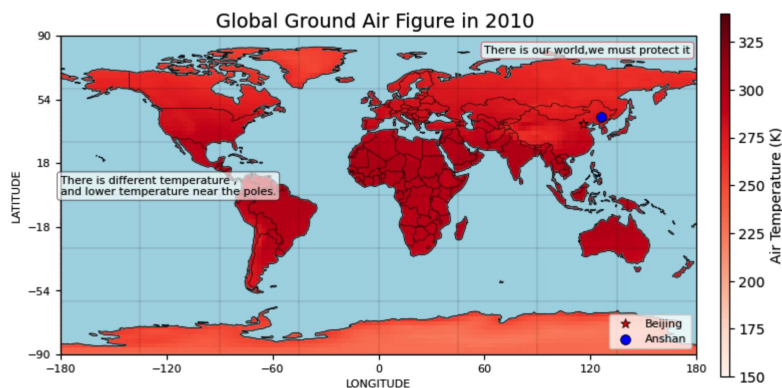
# x label and ticks
ax.tick_params(labelsize=8)
ax.set_xticks(np.linspace(-180, 180, 7))
ax.set_xlabel('LONGITUDE',fontsize=8)
# y label and ticks
ax.set_yticks(np.linspace(-90, 90, 6))
ax.set_ylabel('LATITUDE',fontsize=8)
# text box
ax.text(-180,0,'There is different temperature ,\nand lower temperature near the poles.',
        fontsize=8,bbox=dict(boxstyle='round,pad=0.3', fc='white', ec='black',lw=0.5 ,alpha=0.7))
ax.text(60,80,'There is our world,we must protect it',
        fontsize=8,bbox=dict(boxstyle='round,pad=0.3', fc='white', ec='red',lw=0.5 ,alpha=0.7))
# annotations
ax.add_feature(cfeature.OCEAN, facecolor='lightblue',zorder=1)
ax.add_feature(cfeature.COASTLINE,linewidth=0.5,zorder=2)
# legend
ax.scatter(116,40,s=50,c='r',marker='*',label='Beijing',edgecolors='k', linewidths=0.5)
ax.scatter(126,44,s=50,c='b',marker='o',label='Anshan',edgecolors='k', linewidths=0.5)
ax.legend(loc='lower right',fontsize=8)

/Users/zcjysustech/opt/anaconda3/envs/ese5023/lib/python3.9/site-packages/cartopy/crs.py:825: ShapelyDeprecationWarning: __len__ for multi-part geometries is deprecated and will be removed in Shapely 2.0. Check the length of the `
geoms` property instead to get the number of parts of a multi-part geometry.
  if len(multi_line_string) > 1:
/Users/zcjysustech/opt/anaconda3/envs/ese5023/lib/python3.9/site-packages/cartopy/crs.py:836: ShapelyDeprecationWarning: __len__ for multi-part geometries is deprecated and will be removed in Shapely 2.0. Check the length of the `
geoms` property instead to get the number of parts of a multi-part geometry.

```

并且绘制出全球图像

Out [83]: <matplotlib.legend.Legend at 0x181f2f250>



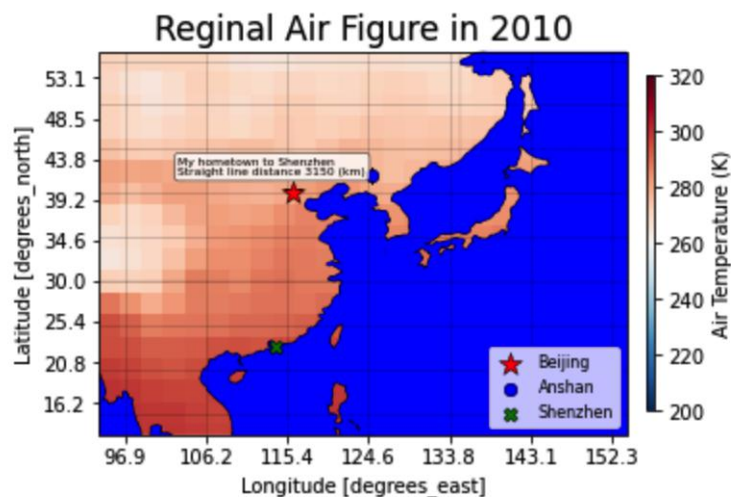
2.2 题目叙述[10 points] Make a regional map of the same variable. Your figure should contain: a different project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box (1 point each).

和上一题类似，只是需要更加精确，绘制的是一个局部图像

```
In [91]: # a different project
proj = ccrs.PlateCarree()
ax = plt.axes(projection=proj) #默认步骤
ax.gridlines(crs=ccrs.PlateCarree(),xlocs=list(np.linspace(-180,180,40)),ylocs=list(np.linspace(-90,90,37)),
            linewidth=0.5, color='black', alpha=0.3,zorder=3)
# x label and ticks
ax.set_xticks(np.linspace(-180, 180, 40))
ax.set_xlabel('Longitude ',fontsize=10)
# y label and ticks
ax.set_yticks(np.linspace(-90,90, 40))
ax.set_ylabel('Latitude ',fontsize=10)
#plot extend area
extent = [shenzhen_lon-20, shenzhen_lon+40, shenzhen_lat-10, shenzhen_lat+30]
ax.set_extent(extent)
# mask and features
ax.add_feature(cfeature.OCEAN, facecolor='blue', zorder=2)
ax.add_feature(cfeature.COASTLINE,facecolor='none', edgecolor='k', linewidth=2)
# add gridlines
gl = ax.gridlines(crs=ccrs.PlateCarree(), linewidth=0.1, color='black', alpha=1)
gl.ylocator = mticker.FixedLocator(np.arange(-90,90,30))
gl.xlocator = mticker.FixedLocator(np.arange(-180, 180, 45))
# legend
ax.scatter(116,40,s=150,c='r',marker='*',label='Beijing',edgecolors='k', linewidths=0.5,zorder=5)
ax.scatter(125,42,s=50,c='b',marker='o',label='Anshan',edgecolors='k', linewidths=0.5,zorder=3)
ax.scatter(114.06,22.54,s=50,c='g',marker='x',label='Shenzhen',edgecolors='k', linewidths=0.5,zorder=4)
ax.legend(loc='lower right',fontsize=8)
# plot colorbar
ds.air.mean('time').plot(transform=ccrs.PlateCarree(),zorder=0,cmap='RdBu_r',vmin=200,vmax=320,
                        add_colorbar=True,cbar_kwargs={'shrink':0.8,'pad':0.03,'aspect':40,'label':'Air Temperature (K)'})
# add a title
ax.set_title("Reginal Air Figure in 2010",fontsize=17)
# add text box
ax.text(103,42,'My hometown to Shenzhen\nStraight line distance 3150 (km)',c='k',fontsize=6,
        bbox=dict(boxstyle='round,pad=0.3', fc='white', ec='black',lw=0.5 ,alpha=0.8))
plt.show()
```

/Users/zcjysustech/opt/anaconda3/envs/ese5023/lib/python3.9/site-packages/cartopy/crs.py:825: ShapelyDeprecationWarning: `__len__` for multi-part geometries is deprecated and will be removed in Shapely 2.0. Check the length of the `geoms` property instead to get the number of parts of a multi-part geometry.
if len(multi_line_string) > 1:
/Users/zcjysustech/opt/anaconda3/envs/ese5023/lib/python3.9/site-packages/cartopy/crs.py:836: ShapelyDeprecationWarning: `__len__` for multi-part geometries is deprecated and will be removed in Shapely 2.0. Check the length of the `geoms` property instead to get the number of parts of a multi-part geometry.

每一个点都有做，一点一分，最终得到以我们深圳为中心的局部地



区，之前课程有做过类似的。