Assignment 04

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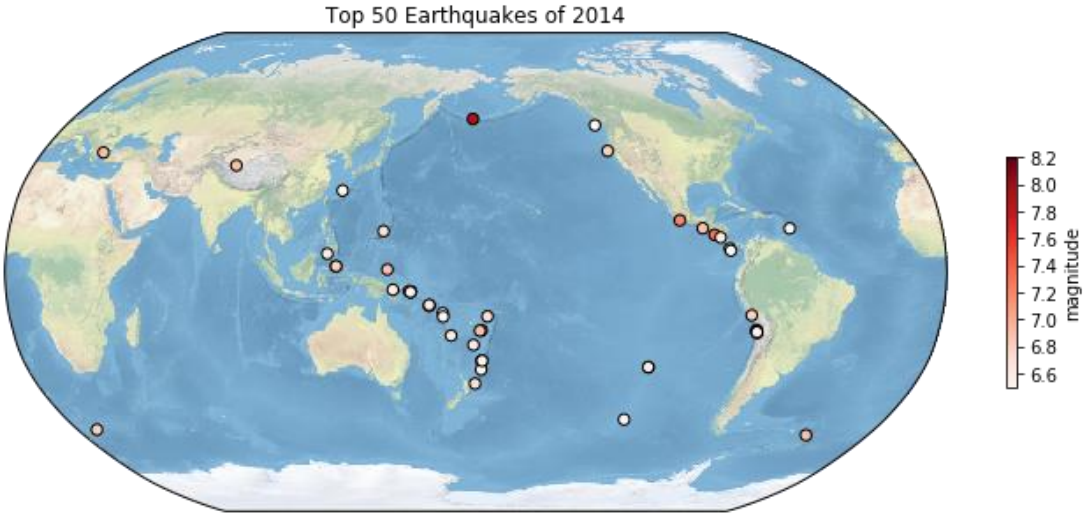
1. Global Earthquakes

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. **[10 points]**



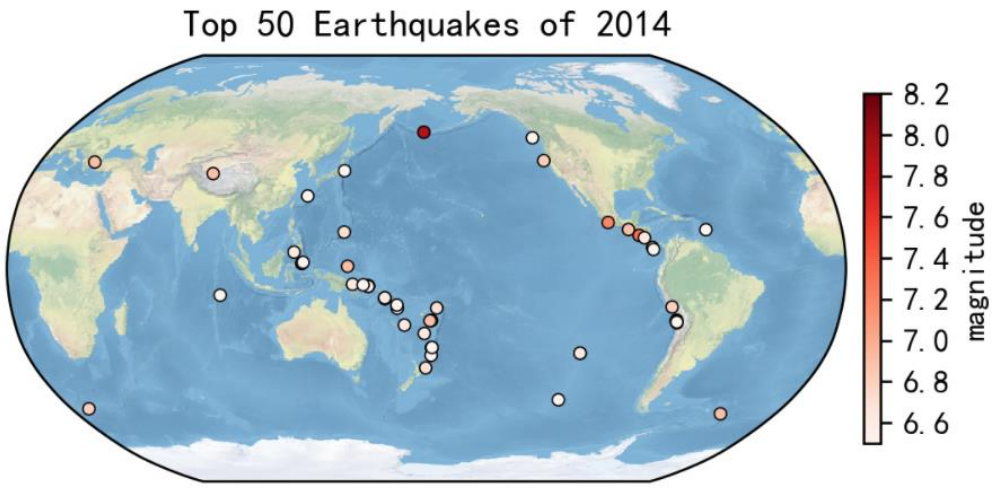
代码：

```
import numpy as np
import xarray as xr
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.ticker as mticker
import cartopy.crs as ccrs
import cartopy.feature as cfeature
%matplotlib inline
Sig_Eqs = pd.read_csv('usgs_earthquakes.csv')
Eqs_location_mag = Sig_Eqs[['latitude','longitude','mag']]
Eqs_location_mag.sort_values(by = 'mag',axis
=0,ascending=False,inplace=True)
Eqs_location_mag_top50 = Eqs_location_mag[:54] #选前 50 个，但是第 51 个到
54 个都是和第五十个一样 mag 为 6.5,所以都算在前 50 了，否则图会比题目给的少几个点
Eqs_location_mag_top50
lat = Eqs_location_mag_top50['latitude'].values
lon = Eqs_location_mag_top50['longitude'].values
mag = Eqs_location_mag_top50['mag'].values
Eqs_location_mag_top50 = Eqs_location_mag_top50.reset_index(drop=True)
max_mag = Eqs_location_mag_top50['mag'][0]
min_mag = Eqs_location_mag_top50['mag'][53]
plt.figure(figsize=(5,5), dpi=100)
```

```
ax = plt.axes(projection=ccrs.Robinson(central_longitude=180))
ax.stock_img()
ax.scatter(lon,lat,c=mag ,transform=ccrs.PlateCarree(),vmin= min_mag,
vmax= max_mag , cmap='Reds',
           marker='o',edgecolors='k',s=15, linewidths=0.5)
cb=ax.figure.colorbar(ax.collections[0],fraction=0.02, pad=0.02,label =
'magnitude') #显示 colorbar
ax.set_title('Top 50 Earthquakes of 2014')
plt.show()
```

输出结果：

```
C:\Users\Cao Zhe\Anaconda3\lib\site-packages\ipykernel_launcher.py:11: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # This is added back by InteractiveShellApp.init_path()
```



分析：

本题需要提取 2014 年所有的地震震级的 top50，但在输出排序后的震级发现，第 50 到第 54 的震级都是 6.5 级，所以全部算作 top50，最后得到的图也和题目所给的图完全一致。

2. Explore a netCDF dataset

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.

2.1 [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 (**1 point each**).

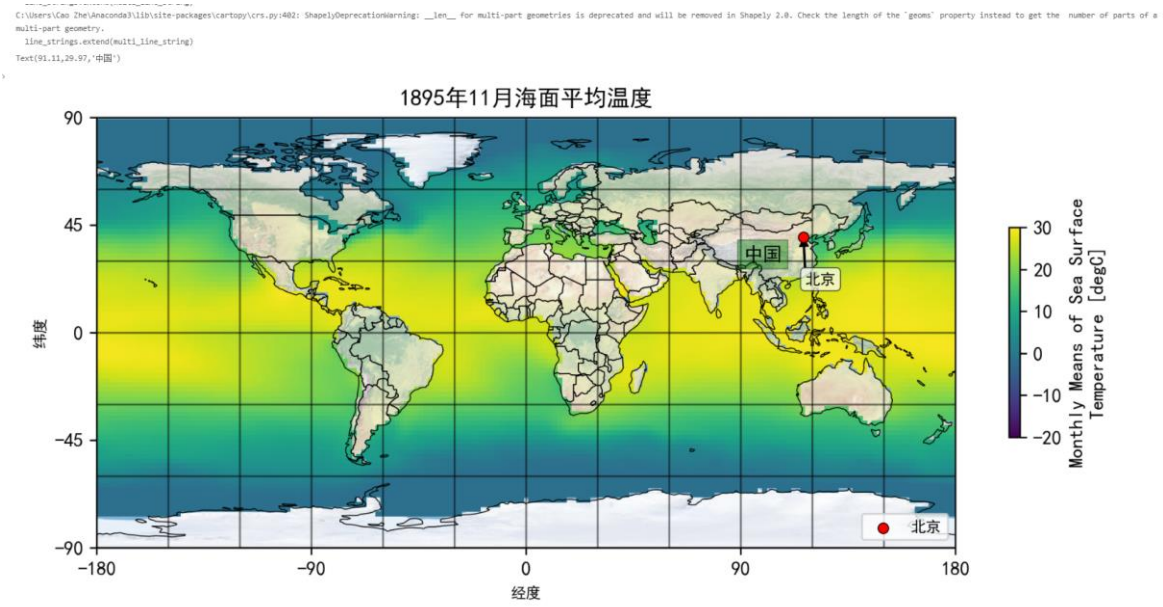
代码：

```
import numpy as np
import xarray as xr
import pandas as pd
import matplotlib.pyplot as plt
```

```
import matplotlib.ticker as mticker
import cartopy.crs as ccrs
import cartopy.feature as cfeature
%matplotlib inline
plt.rcParams['font.sans-serif'] = ['SimHei']
plt.rcParams['axes.unicode_minus'] = False #解决中文及负号乱码问题

ds = xr.open_dataset('sst.mnmean.nc', engine="netcdf4")
surface_T = ds.sst.isel(time=502) #time 用来控制时间，suface_t 代表某年某月
的全球海平面气温,本次取 1895 年 11 月的海平面月平均温度
# Create and define the size of a figure object
plt.figure(figsize=(10,5), dpi=240)
# Create an axes with Orthographic projection style
proj = ccrs.PlateCarree()
ax = plt.axes(projection=proj)
# Plot the surface temperature 自动生成 colorbar
surface_T.plot(ax=ax, transform=ccrs.PlateCarree(),
         vmin=-20, vmax=30, cbar_kwargs={'shrink': 0.4})
ax.stock_img()
# Add border lines over countries
ax.add_feature(cfeature.NaturalEarthFeature(category='cultural',
                                            name='admin_0_countries',
                                            scale='110m',
                                            facecolor='none',
                                            edgecolor='black',
                                            linewidth=0.5))
#x&y label and ticks
ax.tick_params(labelsize=10)
ax.set_xticks(np.linspace(-180, 180, 5), crs=ccrs.PlateCarree())
ax.set_yticks(np.linspace(-90, 90, 5), crs=ccrs.PlateCarree())
ax.set_xlabel('经度',fontsize=8)
ax.set_ylabel('纬度',fontsize=8)
#title
ax.set_title('1895 年 11 月海面平均温度')
#gridlines
gl = ax.gridlines(crs=ccrs.PlateCarree(), linewidth=1, color='black',
alpha=0.5)
gl.ylocator = mticker.FixedLocator(np.arange(-90,90,30))
gl.xlocator = mticker.FixedLocator(np.arange(-180, 180, 30))
#masks or feature
ax.scatter(116.3,39.9,s=30,c='r',marker='o',label='北京
',zorder=5,edgecolors='k', linewidths=0.5)
#legend
ax.legend(loc=4,fontsize=8)
```

```
#annotations
ax.annotate('北京',xy=(116.3,39.9),xytext=(117,20),fontsize=8,
            arrowprops=dict(lw=0.3,width=1,headwidth=5,headlength=5,col
or='k'),
            bbox=dict(boxstyle='round,pad=0.3', fc='white',
ec='black',lw=0.5 ,alpha=0.7))
#text box
ax.text(91.11,29.97,'中国',
        fontsize=10,bbox=dict(boxstyle='square,pad=0.3', fc='g',
ec='black',lw=0.5 ,alpha=0.4))
```

输出结果：



分析：

本题我选择历年月平均海平面温度数据，选择了 1895 年 11 月的全球海平面温度进行输出，结果如上图所示，题目中所要求的 a project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box 均有体现出来。

2.2 [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**).

代码：

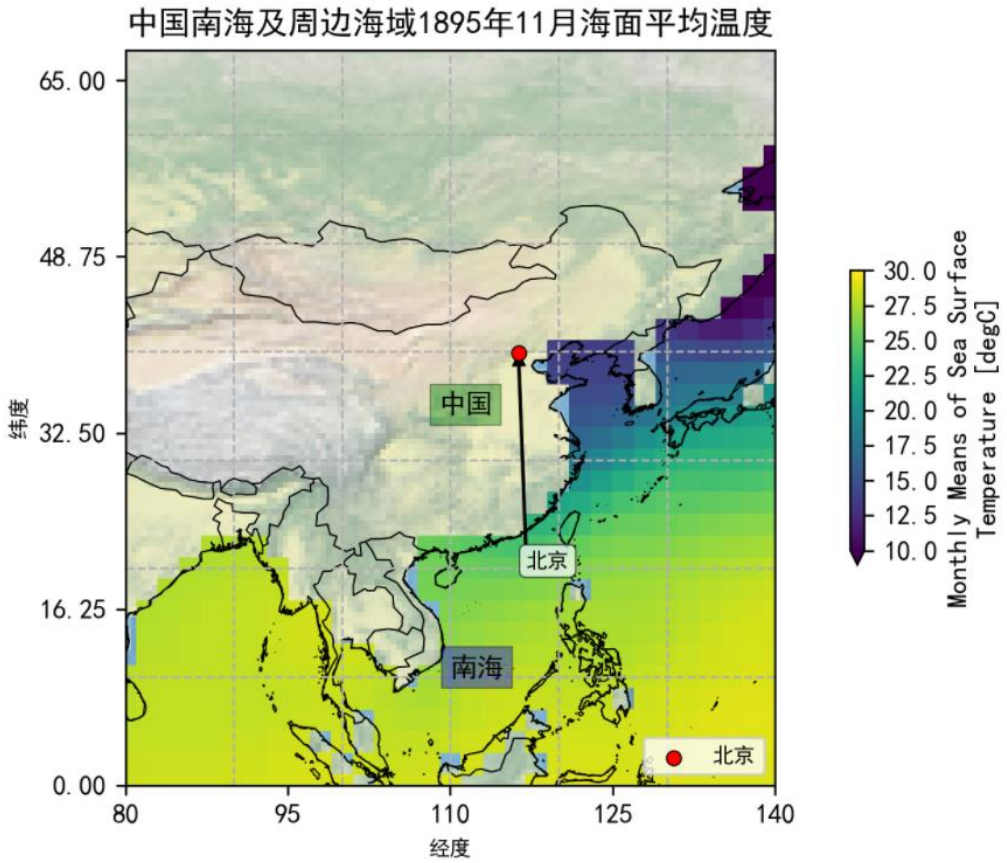
```
import numpy as np
import xarray as xr
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.ticker as mticker
import cartopy.crs as ccrs
import cartopy.feature as cfeature
%matplotlib inline
```

```
plt.rcParams['font.sans-serif'] = ['SimHei']
plt.rcParams['axes.unicode_minus'] = False #解决中文及负号乱码问题

ds = xr.open_dataset('sst.mnmean.nc', engine="netcdf4")
surface_T = ds.sst.isel(time=502) #time 用来控制时间，suface_t 代表某年某月
的全球海平面气温,本次取 1895 年 11 月的海平面月平均温度
# Create and define the size of a figure object
plt.figure(figsize=(10,5), dpi=240)
# Set Orthographic projection style
proj = ccrs.PlateCarree()
ax = plt.axes(projection=proj)

# Plot the surface temperature 自动生成 colorbar
surface_T.plot(ax=ax, transform=ccrs.PlateCarree(),
         vmin=10, vmax=30, cbar_kwargs={'shrink': 0.4})
# Set a region and plot
ax.set_extent([80, 140, 0, 65])

# Add features to axes using methods
ax.coastlines(resolution='10m', linewidth=0.5)
ax.stock_img()
# Add border lines over countries
ax.add_feature(cfeature.NaturalEarthFeature(category='cultural',
                                            name='admin_0_countries',
                                            scale='110m',
                                            facecolor='none',
                                            edgecolor='black',
                                            linewidth=0.5))
#x&y label and ticks
ax.tick_params(labelsize=10)
ax.set_xticks(np.linspace(80, 140, 5), crs=ccrs.PlateCarree())
ax.set_yticks(np.linspace(0, 65, 5), crs=ccrs.PlateCarree())
ax.set_xlabel('经度',fontsize=8)
ax.set_ylabel('纬度',fontsize=8)
#title
ax.set_title('中国南海及周边海域 1895 年 11 月海面平均温度')
#gridlines
ax.gridlines(linestyle='--')
#masks or feature
ax.scatter(116.3,39.9,s=30,c='r',marker='o',label='北京
',zorder=5,edgecolors='k', linewidths=0.5)
#legend
ax.legend(loc=4,fontsize=8)
#annotations
```

```
ax.annotate('北京',xy=(116.3,39.9),xytext=(117,20),fontsize=8,
            arrowprops=dict(lw=0.3,width=1,headwidth=5,headlength=5,col
or='k'),
            bbox=dict(boxstyle='round,pad=0.3', fc='white',
ec='black',lw=0.5 ,alpha=0.7))
#text box
ax.text(108.93,34.27,'中国',
        fontsize=10,bbox=dict(boxstyle='square,pad=0.3', fc='g',
ec='black',lw=0.5 ,alpha=0.4))
ax.text(110,10,'南海',
        fontsize=10,bbox=dict(boxstyle='square,pad=0.3', fc='b',
ec='black',lw=0.5 ,alpha=0.4))
```

输出结果：

```
C:\Users\Cao Zhe\Anaconda3\lib\site-packages\cartopy\crs.py:402: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely
  line_strings.extend(multi_line_string)
C:\Users\Cao Zhe\Anaconda3\lib\site-packages\cartopy\crs.py:402: ShapelyDeprecationWarning: __len__ for multi-part geometries is deprecated and will be removed in Shapely 2.
  line_strings.extend(multi_line_string)
Text(110,10,'南海')
```



分析：

本题我选择历年月平均海平面温度数据，选择了南海及其周边海域 1895 年 11 月的全球海平面温度进行输出，结果如上图所示，题目中所要求的 a project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box 均有体现出来。