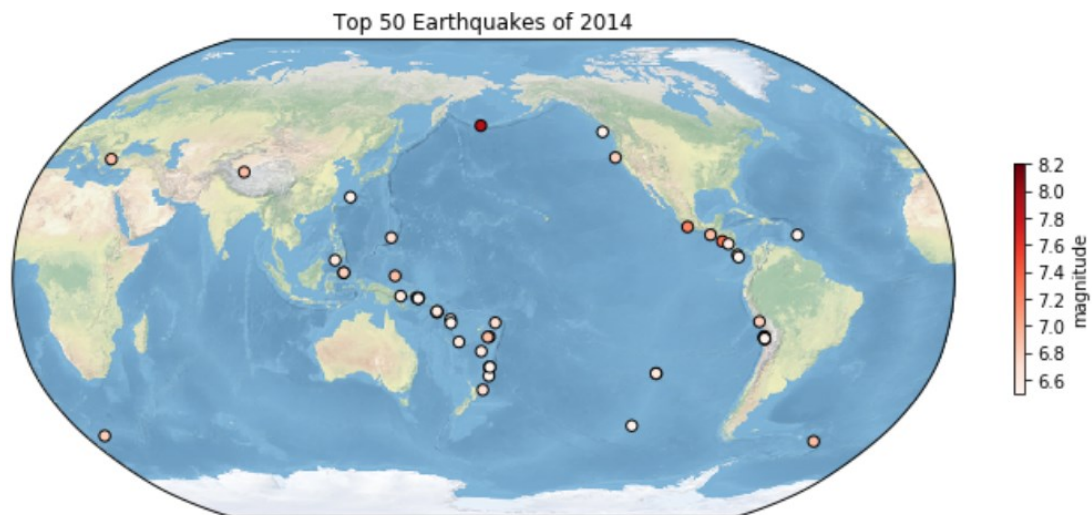# 1. Global Earthquakes

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]**


思路：我从 CHATGPT 和冯汇然同学的交谈中得到灵感，首先读取 usgs_earthquakes.csv 数据，然后根据 mag 列降序排序，选取前 50 的数据保存为 top50_mag。然后利用 Robinson 投影画地图，并在地图上添加 top50_mag 的地点，mag 的数值用渐变色代表。

```
In [2]: # Read a csv file
        usgs = pd.read_csv("usgs_earthquakes.csv")
        # Check information
        #usgs.info()
        usgs
        #选择前50 mag 的地震
        # Sort in descending order
        top50_mag=usgs.sort_values("mag", ascending=False).head(50)
        top50_mag
```

```
In [13]: ###画图
         plt.figure(figsize=(12,10), dpi=300)
         # 创建投影
         ax = plt.axes(projection=ccrs.Robinson(central_longitude=180))
         # 设置地图范围
         ax.stock_img()
         # Add title
         ax.set_title('Top 50 Earthquakes of 2014')
         # # # 获取前50的数据
         lons = top50_mag['longitude']
         lats = top50_mag['latitude']
         values = top50_mag['mag']

         # 绘制散点，根据值确定颜色
         sc = ax.scatter(lons,lats,c=values, s=50,cmap='Reds',edgecolors='k',transform=ccrs.PlateCarree())# transform=ccrs
         # 添加颜色图例
         cbar = plt.colorbar(sc, ax=ax, orientation='vertical', shrink=0.3, pad=0.03)
         cbar.set_label('magnitude')
         # 显示地图
         plt.show()
```

Top 50 Earthquakes of 2014
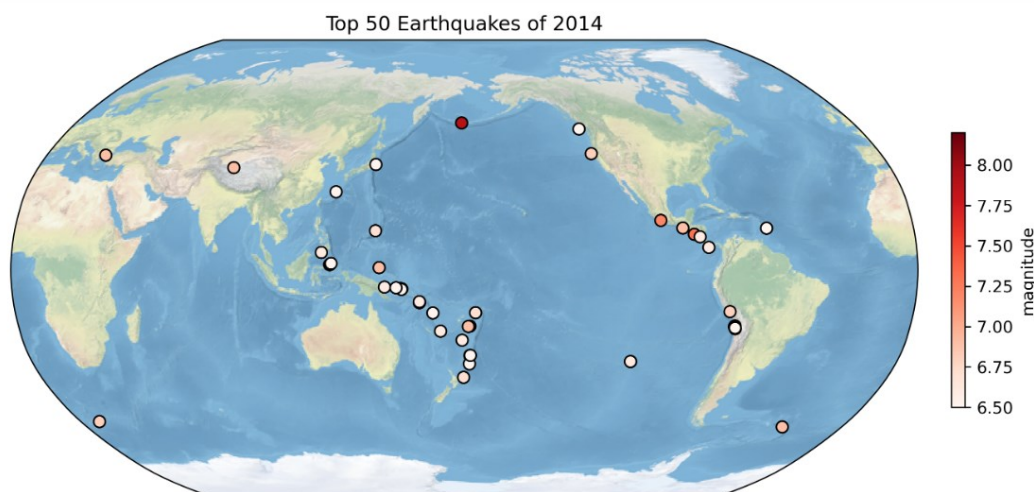
2. Explore a `netCDF` dataset

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**).

思路：我从 CHATGPT 和 section09 中得到灵感，首先读取 hgt.2017z.nc 数据，选取 500hPa 5 月逐日位势高度场按照时间纬度取均值，得到 500hPa 5 月平均位势高度场，并在 PlateCarree(投影下，画出它在全球范围的热力图。

```
In [69]:  # 设置图框
          plt.figure(figsize=(12,10), dpi=300)
          # 创建投影
          ax = plt.axes(projection=ccrs.PlateCarree(central_longitude=180))

          #  画500hgt位势高度场
          plt.imshow(hgt_box, cmap='coolwarm', interpolation='nearest',aspect='auto',transform=ccrs.PlateCarree()) #

          ## 添加颜色条
          cbar = plt.colorbar(ax.imshow([[hgt_box_min,hgt_box_max],[hgt_box_min,hgt_box_max]], cmap='coolwarm'), ax=ax, shrink=0.4)
          cbar.ax.set_ylabel('hgt', fontweight='bold')

          ## 添加网格线
          gl = ax.gridlines(draw_labels=True,linewidth=1, color='gray', linestyle='--')
          gl.top_labels = False
          gl.right_labels = False

          ## 添加地图特征
          ax.add_feature(cfeature.OCEAN, facecolor='lightblue')
          ax.add_feature(cfeature.LAND, facecolor='beige')
          ax.add_feature(cfeature.COASTLINE, linewidth=0.5, edgecolor='black')
          ax.add_feature(cfeature.BORDERS, linewidth=0.5, edgecolor='black')

          ## 设置坐标轴标签和标题
          ax.set_xlabel('Longitude', fontweight='bold')
          ax.set_ylabel('Latitude', fontweight='bold')
          ax.set_title('500hPa hgt in global world', fontweight='bold')

          # 添加图例
          ax.scatter(116.41,39.91, transform=ccrs.PlateCarree(), label='Cities')
          ax.legend(loc='lower right')

          # 添加文本框和注释
          ax.text(109.52-180,18.26, 'Sanya', bbox=dict(facecolor='white', alpha=0.9))   #在这个位置添加文本框
          ax.annotate('Guilin', xy=(110.18-180, 25.24), xytext=(125.25-180, 25.54),     #注释某点
                      arrowprops=dict(facecolor='yellow',shrink=0.05),fontsize=9, fontweight='bold', fontfamily='serif', color='yellow')

          plt.show()
```
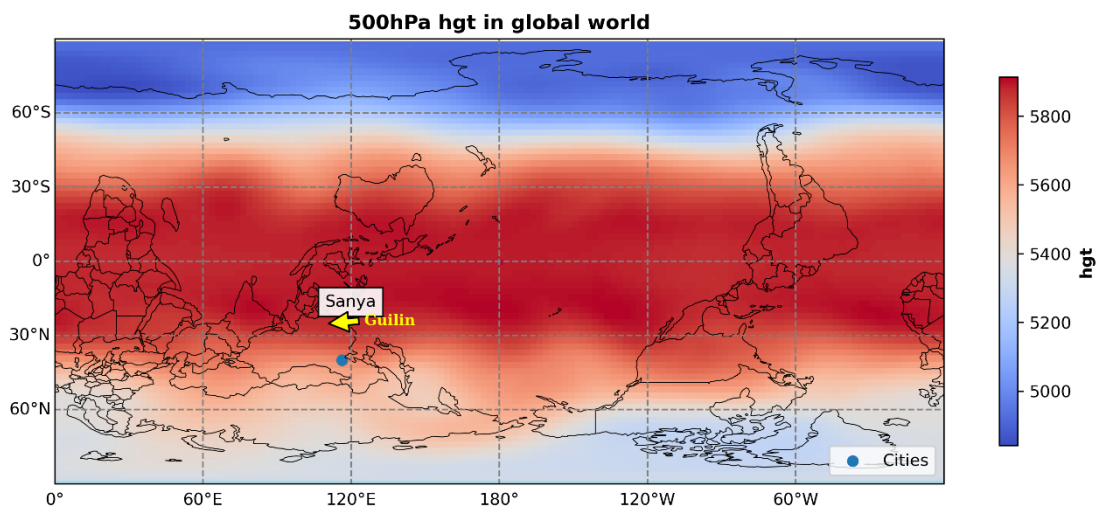

2.2 [10 points] Make a regional map of the same variable. Your figure should contain: a different project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box (**1 point each**).

思路：我从 CHATGPT 和 section09 中得到灵感，首先读取 hgt.2017z.nc 数据，选取 500hPa 5 月逐日位势高度场按照时间纬度取均值，得到 500hPa 5 月平均位势高度场，并在 Robinson 投影下，画出它在中国范围的热力图。

```python
In [67]:  # 创建一个地图对象
          plt.figure(figsize=(12,10), dpi=300)
          # 创建投影
          ax = plt.axes(projection=ccrs.Robinson())
          # 设置中国范围
          ax.set_extent([73.66, 135.05, 3.86, 53.55], crs=ccrs.PlateCarree())
          # 画500hgt位势高度场
          plt.imshow(hgt_box, cmap='coolwarm', interpolation='nearest', aspect='auto',transform=ccrs.PlateCarree())

          # 添加颜色条
          cbar = plt.colorbar(ax.imshow([[hgt_box_min,hgt_box_max],[hgt_box_min,hgt_box_max]], cmap='coolwarm'), ax=ax, shrink=0.6)
          cbar.ax.set_ylabel('hgt', fontweight='bold')
          # 添加地图特征
          ax.add_feature(cfeature.OCEAN, facecolor='lightblue')
          ax.add_feature(cfeature.LAND, facecolor='beige')
          ax.add_feature(cfeature.COASTLINE, linewidth=0.5, edgecolor='black')
          ax.add_feature(cfeature.BORDERS, linewidth=0.5, edgecolor='black')
          # 设置坐标轴标签和标题
          ax.set_xlabel('Longitude', fontweight='bold')
          ax.set_ylabel('Latitude', fontweight='bold')
          ax.set_title('500hPa hgt in China', fontweight='bold')
          # 添加网格线
          gl = ax.gridlines(draw_labels=True,linewidth=1, color='gray', alpha=0.5, linestyle='--')
          gl.top_labels = False
          gl.right_labels = False
          # 添加一些数据
          x = [114.06, 116.41]
          y = [22.55, 39.91]
          labels = ['Shenzhen', 'Beijin']
          # 添加图例
          ax.scatter(x, y, transform=ccrs.PlateCarree(), label='Cities')
          ax.legend(loc='lower right')
          # 添加文本框和注释
          ax.text(109.52,18.26, 'Sanya', bbox=dict(facecolor='white', alpha=0.9),transform=ccrs.PlateCarree())  #在这个位置添加文本框
          ax.annotate('Guilin', xy=(110.18, 25.24), xytext=(112.25, 25.54),    #注释某点
                      arrowprops=dict(facecolor='yellow',shrink=0.05),fontsize=9, fontweight='bold', fontfamily='serif', color='yellow',tran
          plt.show()
```


500hPa hgt in China