Homework #4

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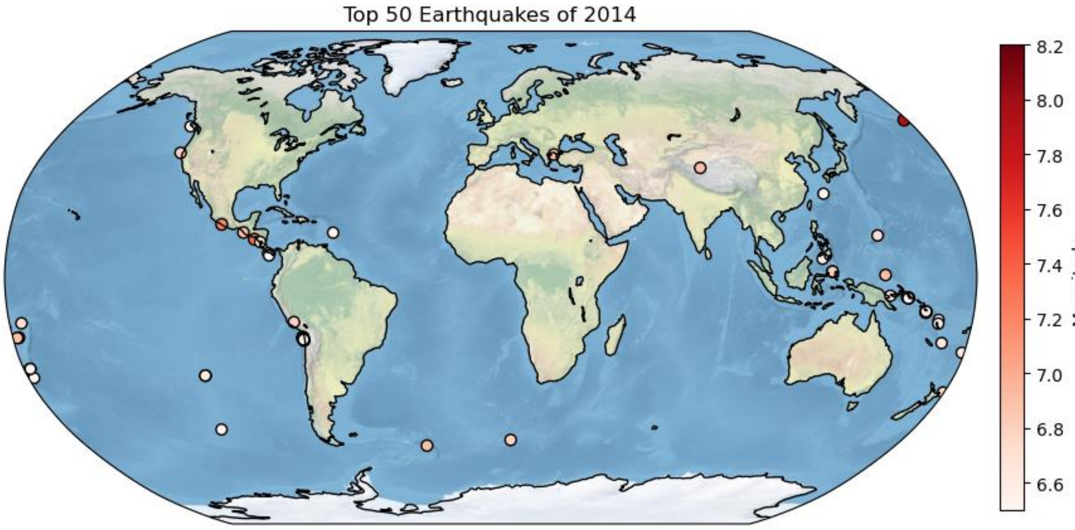
Problem 1: In this problem set, we will use this file from the USGS Earthquakes Database. The dataset is similar to the one you use in Assignment 02. Use the file provided (usgs_earthquakes.csv) to recreate the following map. Use the mag column for magnitude. **[10 points]**

Answer: First, import the necessary libraries, including **pandas, xarray, matplotlib**, and **cartopy**. Then, use the pd.read_csv function to read the earthquake dataset named "**usgs_earthquakes.csv**" and store it in a DataFrame called **Sig_Eqs**. Utilize the pd.to_datetime function to convert the "time" column in Sig_Eqs to a datetime format. Apply a time condition to filter earthquake data from the dataset for the year 2014, creating a DataFrame named **Sig_Eqs_2014**. Sort Sig_Eqs_2014 based on earthquake magnitude using the nlargest function, and select the top 50 earthquake events to create a DataFrame named **top_50_eqs**.

Next, create a plot using the plt.subplots function to generate a canvas and coordinate axes. Set the projection of the coordinate axes to PlateCarree, add a world map background using the ax.stock_img function, and incorporate map features such as coastlines, land, and lakes using the ax.add_feature function.

Plot earthquake points on the map using the ax.scatter function, providing longitude, latitude, and magnitude as parameters. Set attributes such as color, marker, size, and transparency. Finally, add additional elements to the plot, including a color bar, set the plot title, and display the graph to complete the drawing.The final graph is as follows:



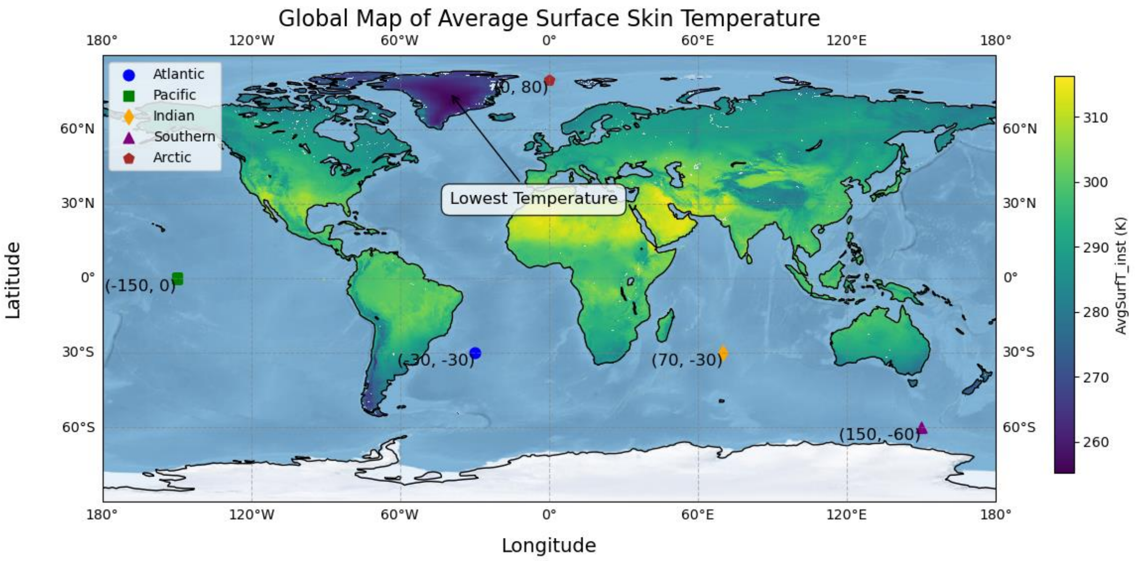
Problem 2: Browse the NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC) website. Search and download a dataset you are interested in. You are also welcome to use data from your group in this problem set. But the dataset should be in netCDF format. For this problem set, you 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)**.

Answer: Firstly, we import the necessary libraries, including **xarray, matplotlib, and cartopy**. Next, we use the xr.open_dataset() function to read the netCDF file named "**GLDAS_NOAH025_M.A202308.021.nc**" and store the dataset in the variable **ds**. Then, we extract the surface mean temperature variable using the **ds**[variable_name].squeeze() function and store the result in the variable 'variable'. Afterward, we create a canvas and axes using the plt.subplots() function, set the projection of the axes to PlateCarree, and specify the size of the figure. We add a world map background using the ax.stock_img() function.

Moving on, we plot the global surface mean temperature on the map using the ax.pcolormesh() function, passing longitude, latitude, and surface mean temperature as parameters, and setting the color map. We add map features, including coastlines, land, and lakes, using the ax.add_feature() function. Next, we label the five oceans and add a legend. We use a loop to iterate through the oceans in the dictionary 'oceans,' including their corresponding longitude, latitude, color, marker, and size. We use the ax.scatter() and ax.text() functions for labeling and annotation.

Subsequently, we add x and y labels, ticks, and a title using the ax.set_xlabel(), ax.set_ylabel(), ax.text(), and plt.title() functions. We add gridlines, a legend, and a color bar using the ax.gridlines(), ax.legend(), and plt.colorbar() functions, setting the appropriate parameters. Finally, we add annotations and a text box to the figure using the plt.annotate() function, specifying attributes such as arrows, font size, and box style. Lastly, the resulting plot was displayed using plt.show() as shown below:

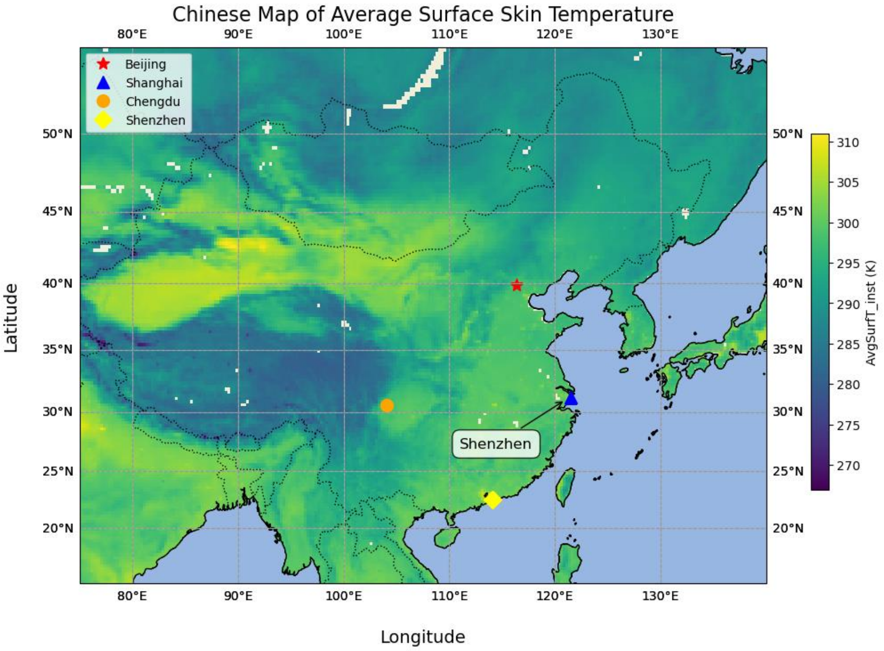


2.2 [10 points] Make a regional map of the same variable. Your figure should contain: a different project, x label and ticks, y label and ticks, title, gridlines, legend, colorbar, masks or features, annotations, and text box **(1 point each)**.

Answer: First, the code begins by importing the required libraries, including xarray, matplotlib, and cartopy. Then, the xr.open_dataset() function is used to read the netCDF file named "**GLDAS_NOAH025_M.A202308.021.nc**," and the dataset is stored in the variable **ds**. Next, the surface average temperature variable is extracted from the dataset, the range of the Chinese region is defined, and data for the Chinese region is extracted using the sel function.

Afterward, a canvas and axes are created using the plt.subplots() function, and the projection of the axes is set to PlateCarree, specifying the size of the figure. The surface average temperature of the Chinese region is plotted on the map using the ax.pcolormesh() function, with longitude, latitude, and surface average temperature as parameters, and a color map is set. Map features such as coastlines, land, and lakes are added using the ax.add_feature() function.

Next, a loop iterates through the dictionary of cities and their corresponding latitude and longitude information. The ax.plot() function is used to mark different cities on the map, and a legend is added. Labels for x and y axes, ticks, and a title are added using ax.set_xlabel(), ax.set_ylabel(), ax.text(), and plt.title() functions. Subsequently, gridlines are added with the ax.gridlines() function, a legend is added with the ax.legend() function, and a color bar is added using the plt.colorbar() function with appropriate parameters. Finally, annotations and text boxes are added to the figure, possibly using the plt.annotate() function, with settings for arrows, font size, and text box style. Ultimately, the plt.show() function is used to display the graph, and the result is as follows:


Chinese Map of Average Surface Skin Temperature
80°E
90°E
100°E
110°E
120°E
130°E
★ Beijing
▲ Shanghai
● Chengdu
◆ Shenzhen
50°N
45°N
40°N
35°N
30°N
25°N
20°N
Latitude
Shenzhen
Longitude
310
305
300
295
290
285
280
275
270
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