**Analysis of global temperature Trends**

**Instructions**

Create a new MATLAB script that generates four figures as outlined below. Save all of your figures as .tif files and insert into a Word document with answers to the questions in #7 below.

**Obtain and plot zonal temperature data**

1. Obtain the data.
	1. From the **NASA GISS** **Datasets and Images** page <http://data.giss.nasa.gov/> navigate to the **GISSTEMP dataset (GISS Surface Temperature Analysis)**.
	2. Obtain zonal annual means of the **Land-Ocean Temperature Index (LOTI)** during 1880 – 2015. Note the baseline climatology period (30-yr range of means from which the anomalies are computed).
2. Plot the data (**Figure 1**).
	1. Generate time series of the zonal annual mean temperatures for 0 – 24°N and 64 – 90°N during 1880 – 2015. Plot both line graphs on the same axes (same figure panel).
	2. On your figure, annotate the baseline period.

**Obtain and plot gridded reanalysis temperature data**

1. Obtain the data.
	1. From the **IRI/LDEO Climate Data Library** <http://iridl.ldeo.columbia.edu/> navigate to **Data by Source**. Select **NOAA** > **NCEP-NCAR** > **CDAS-1** > **MONTHLY** > **Intrinsic** > **Pressure Level** > **Temperature**.
	2. Go to the **Data Selection** tab. Restrict your data to include only 1000-mb pressure surfaces. Next, restrict your data to include only values during the baseline period identified above (January of the first year – December of the last year). Click **Restrict Ranges** and **Stop Selecting**.
	3. Go to the **Data Files** tab. Select **NetCDF**. Save the file locally and rename it.
2. Read and modify the data contained in the NetCDF file.
	1. To see what data are in the file:

**ncdisp('filename.nc')**

* 1. To create MATLAB variables for latitude, longitude, and temperature:

**xlon = double(ncread('filename.nc','X'));**

**ylat = double(ncread('filename.nc','Y'));**

**[xlon ylat] = meshgrid(xlon,ylat);**

**t = double(ncread('filename.nc','temp'));**

* 1. The temperature variable is four dimensions (lon,lat,pressure,time). Since you are only looking at one pressure, the third dimension should have one value. To remove this dimension:

**t = squeeze(t);**

Your temperature dimensions should now be 144x73x360 (lon,lat,time).

* 1. Convert all temperatures to °C. (Hint: check the current units by looking at the output from (a) above.)
	2. Use a loop to group the months into years and compute the annual average values:

**i = reshape(1:360,12,30);**

**for k = 1:30**

 **t\_yr(:,:,k) = mean(t(:,:,i(:,k)),3); %what is the 3 doing here?**

**end**

* 1. Compute the 30-yr average temperature at each location:

**t\_ave = mean(t\_yr,3);**

1. Plot the data (**Figure 2**).
	1. Create a global map with annual average temperatures during the baseline period.

**coast = load('coast'); %loads global geographical information for mapping**

**figure %opens a figure window**

**axesm('robinson','Frame','on','grid','on','ParallelLabel','on','MapLonLimit',[0 360])%creates the mapping figure**

**contourfm(ylat,xlon,t\_ave',20,'linestyle','none') %plots the data**

**geoshow(coast.lat, coast.long, 'Color', 'black','linewidth',1) %plots the continents**

**colorbar('fontsize',8) %inserts a colorbar**

**colormap('jet') %sets the color scheme (see what other options are available!)**

**axis off %gets rid of white background**

**tightmap %makes the plot fill the whole frame**

**caxis([-30 30]) %use this function to define a data range; change it to encompass an appropriate range of values**

**title('Include a title here','fontsize',12)**

Verify the accuracy of your figure by comparing it to an annual climate composite generated using the NOAA PSD ESRL Interactive Climate Analysis and Plotting site <http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl> .

1. Obtain and plot data for 2015.
	1. From the **IRI/LDEO Climate Data Library**, obtain 1000 mb temperature data for 2015. Convert temperatures to °C and compute the annual average values. Create two additional maps of temperatures during 2015:
	2. **Figure 3:** Plot the actual temperatures during this year.
	3. **Figure 4:** Plot the temperature deviations (anomalies) from the baseline period identified above.

**Analyze your results**

1. Use your figures to answer the following questions.
	1. How do the 0 – 24°N temperatures differ from the 64 – 90°N temperatures? Why do you think this is this the case?
	2. How do Figures 2 and 3 differ? How are they similar?
	3. Explain how Figure 4 incorporates information from both Figures 2 and 3 (use specific examples).
	4. Which map (Figures 2 – 4) includes the data also presented in Figure 1? Explain how these are similar (use specific examples).
	5. If the baseline period was 1981 – 2010, would any of your figures change? How?