Assignment: Module 1

Learning Goals

Subject knowledge:

- Seasonal cycle of precipitation and monsoon onset
- Trend and seasonal cycle of Arctic sea ice
- Ocean surface currents and thermodynamic conditions
- Reversal of low-level wind associated with the South Asian monsoon

Analysis skills:

- Learn how to read netCDF data
- Learn how to read grib data
- Learn how to extract a field variable over a certain latitude-longitude domain
- Learn how to make latitude-time plots (longitude-time plots, or the so-called Hovmöller diagrams, are similar)
- Get familiar with an online plotting tool

Problems 1

We have discussed the seasonal variations of precipitation in a lecture by comparing the long-term mean precipitation in February and August. Another way to illustrate the seasonal variations of a field variable is to use a time-latitude plot.

1) Please make such a plot for precipitation following the steps below:

- read the long-term mean monthly mean precipitation data from Jan-Dec
- extract the precipitation data over a specific domain (90-150°E, 30°S-30°N)
- average precipitation over longitude between 90-150°E, which yields a 2D array as a function of latitude and month.
- show precipitation in a contour plot, with the x-axis as month and the y-axis as latitude.

2) Could you estimate the long-term mean monsoon onset time along 15°N based on your plot?

Input data: https://psl.noaa.gov/data/gridded/data.gpcp.html. The data can also be found on Keeling at "/data/zhuowang/b/zhuowang/Data/GPCP/precip.mon.ltm.nc"

Incomplete sample script: precip_tlat_sample.py

Note: You need to replace "…." In the incomplete script.

Problems 2

The Arctic sea ice is quickly declining in recent decades.

1) Please plot the monthly mean sea ice concentration from the ERA-5 reanalysis for September 1987 and September 2012, and briefly describe the sea ice concentration changes you see.

2) Please plot the monthly mean sea ice concentration from the ERA-5 reanalysis for March 1987 and March 2012. Do you still see a large reduction of sea ice concentration as in September? If not, how do you understand the different results?

Input data (ERA-5 reanalysis):
/data/zhuowang/b/zhuowang/Data/DS627.1/SFC/ei.moda.an.sfc.regn128sc.YYYYMM0100, where YYYY and MM denote the four-digit year and two-digit month, respectively.

Incomplete sample script: plot-cisfc_sample.py

Problems 3

You have seen schematics of ocean surface currents in a lecture. Here please plot the long-term mean ocean currents at the 5-m depth in vectors using the NCEP Global Ocean Data Assimilation System (GODAS; see more information of the dataset online), and superimpose it on the 5-m potential temperature of the ocean.

Input data (long-term mean u-current, v-current and potential temperature GODAS ocean reanalysis):

/data/zhuowang/c/zhuowang/Data/GODAS/ucur.mon.ltm.nc

/data/zhuowang/c/zhuowang/Data/GODAS/vcur.mon.ltm.nc

/data/zhuowang/c/zhuowang/Data/GODAS/pottmp.mon.ltm.nc

Hints: You can use the quiver function from matplotlib to make the vector plots. You may need to adjust the headwidth, headlength and skip some grid points to make your plot more readable. Here is a useful example.

Problems 4

If you are interested in a quick look at the NCEP/NCAR reanalysis data, the NOAA/PSL site below provides a useful tool:

https://psl.noaa.gov/cgi-bin/data/composites/printpage.pl

Please

1) plot the long-term mean 925-hPa wind field between 40°S-40°N using the cylindrical-equidistant map projection in July.

2) plot the long-term mean 925-hPa wind field between 40°S-40°N using the cylindrical-equidistant map projection in January.

3) briefly describe the contrast of the wind field between the two months over the Indian Ocean.