Evaluation of UFS forecast errors

In this assignment you will evaluate the accuracy of precipitation forecast produced by UFS.

One measure of accuracy is the root mean square (rms) error; the smaller the error the better the accuracy. The rms error at each grid point is defined as

where is the forecast lead, or how far away from the initial condition the forecast is; represents the number of ensemble members; represents the number of forecasts; is the forecast anomaly; denotes the observed anomaly (truth).

Data

The forecast consists of one ensemble member of forecasts initialized on the first day of each calendar year month between 04/01/2011 and 12/01/2017. Each forecast is 35 days long. The forecast and observed anomalies are already computed for you and both are on the same longitude, latitude grid. They are stored in netcdf format and are located at

UFS data: /scratch/stan/clim680/data/ufs/ufs.prec.01.anom.nc

OBS data: /scratch/stan/clim680/data/obs/cpcu.prec.anom.nc

The forecast anomalies are stitched together from the first day of each month to reconstruct a continuous year. For example, 01 of each month represents the initial time of the forecast. The second day of each month is the forecast at lead time one day, the third day of each month is the forecast at lead time two days and so on.

The observed anomalies match the same times as the forecasts.

A python script is provided to you to read the data. The script is located at:

/scratch/stan/clim680/code/read.ncdata.py

To run the code:

* module load anaconda
* python read.ncdata.py

If the code runs successfully, your output will look like

<xarray.Dataset>

Dimensions: (lat: 360, lon: 720, time: 2557)

Coordinates:

\* lon (lon) float64 0.25 0.75 1.25 1.75 2.25 ... 358.2 358.8 359.2 359.8

\* lat (lat) float64 -89.75 -89.25 -88.75 -88.25 ... 88.75 89.25 89.75

\* time (time) datetime64[ns] 2011-01-01 2011-01-02 ... 2017-12-31

Data variables:

prec (time, lat, lon) float32 ...

Analysis

1. Seasonal errors
   1. Compute the rms error maps for each season: December-January-February, March-April-May, June-July-August, September-October-November.
   2. Plot the error maps for each season in a separate figure. Use shading to plot the errors and make sure your plots include legend(s).
2. RMS error as a function of lead time
   1. Compute the rms error maps for four forecast leads: week 1, week 2, week 3, and week 4.
   2. Plot the error maps for each lead time in a separate figure. Use shading to plot the errors and make sure your plots include legend(s).