Homework #2
Objective Analysis in the Atmospheric and Related Sciences
ATMO, HWRS, GEOS, GEOG 529: Fall 2013

Data

Monthly mean temperature (°C) and total monthly precipitation data (mm) for two stations in the western United States for the period January 1950 through December 2010 are provided on the website (in ascii and standard binary format). The format of the data is a list of 732 months of data. These data are taken from the UDEL surface temperature and precipitation product, available at the NOAA Earth System Research Laboratory.

Part I

Considering both stations, for each variable (i.e. precipitation and temperature) compute mean, standard deviation, skewness, and kurtosis as a function of calendar month. Show this in graphical format. Normalize the skewness and kurtosis in your plots.

Discussion: Based on the statistical characteristics of precipitation and temperature, what would be likely geographic locations for these two stations? Explain. How do the changes in the statistical characteristics of precipitation and temperature relate to the seasonal variability of climate at the stations?

Part II

Plot the frequency distributions (i.e. histograms) of observed temperature and precipitation at both stations for: (a) all winter months (DJF), and (b) all summer months (JJA). You will need to use a reasonable bin size for your histogram, which you should be able to gauge by your analysis in Part I.

Following example 4.11 in Wilks (p.112), superimpose the corresponding Gaussian (or normal) and gamma distributions on the histograms with the same scaling. For the normal distribution, state the mean (μ) and the standard deviation (σ). For the gamma distribution, state the values of the shape parameter (α) and the scale parameter (β). Your final figures for this part should look equivalent to Fig. 4.15 in Wilks

Discussion: Do Gaussian or gamma distributions best describe the observed frequency distributions for precipitation and temperature at these two stations? How are the distributions similar or different between the stations and the seasons and why? Given the estimated geographic locations of these stations from Part I, discuss the climatological factors that would influence the distribution of temperature and precipitation in the cool and warm seasons.

Part III

Perform a χ^2 goodness of fit test to quantitatively assess whether a Gaussian or gamma distribution is most appropriate to fit the observed distributions of temperature and precipitation. Show relevant steps in your work. Using the distribution that best fits the data, determine the value for a one in twenty-five year temperature and precipitation event. What specific months and years did such any such events actually occur at the two sites?

Discussion: What times of year are these sites most susceptible to temperature and precipitation extremes and why? Why is knowledge of the probability of extreme precipitation or temperature events societally important? If climate is expected to be more extreme in the future in accordance with current IPCC projections, provide some well-reasoned arguments about how the shape of these distributions might change later this century.

Assignment due date: Thursday, Sep. 19