Advanced Data Analysis Homework #7 & #8

Due: December 4, 2008

The purpose of these assignments is to introduce you to performing EOF analysis on real climate data and to understand and interpret EOF analysis in an actual research paper. Together, after doing this assignment, you should at least be more comfortable at looking at and computing EOFs and PCs.

When submitting the assignment, please submit each portion as separate files for easier grading.

Homework #7:

The AMS Journal of Climate editor has asked you to review the following paper:

Quadrelli, R., and J. M. Wallace, 2004: A simplified linear framework for interpreting patterns of Northern Hemisphere wintertime climate variability. *J. Climate*, **17**, 3728-3744.

Your "review" should be about 2 pages long, single spaced, and should include a *brief* summary of the paper and then your critiques of the paper. Your critiques should include choice of methods, figure choices, and readability/clarity of the paper. If you have suggestions for other analyses, offer them!

Homework #8:

Download the following dataset from the website: NH_1000mb_heights.txt. The file contains the monthly-mean Northern Hemisphere (poleward of 20°N) geopotential heights (m) from the NCEP/NCAR reanalysis at 1000 mb from 1958 - 2007. Your task is to compute the first three modes of variability in the 1000 mb height field for the *NH wintertime (i.e., November through March; NDJFM).*

Here are some helpful hints:

1. The horizontal grid is as follows: Longitude: from $-360°$ to $-2.5°$, every 2.5°; Latitude: from 90°N to 20°N, every 2.5°.
2. The data matrix is 600 x 4176. The first row is the data for January 1958 and the last row is the data for December 2007. Going across, the first 144 elements correspond to

the height anomalies at all longitudes for 90°N, the second 144 elements for 87.5°N, etc.

3. Remove the seasonal cycle from the field at every grid point to create anomalies.

4. Pull out the NDJFM values from the dataset.

5. Because the data are gridded, you must weight each grid point by $\sqrt{(cos\phi)}$, where ϕ is latitude (multiply the time series at each grid point by this quantity).

6. You can use either SVD or eigenanalysis of the covariance matrix to decompose the field.

7. For presentation of the spatial patterns, regress the unweighted NDJFM 500 mb heights onto the standardized PCs separately (you will have 3 maps, one for each mode). On the title of your figures, write "Regression of 1000 mb heights onto PC-(num) - (var)", where "num" is the mode number (1-3) and "var" is the percent variance explained by that particular mode. Use appropriate contour intervals/contour shading, and put correct units in the caption and on the colorbar (if used).

In addition to these figures (both the spatial maps and the time series of each mode), for the first 10 eigenvalues, plot the variance explained by each mode as a function of the eigenvalue number.

Discuss your results and interpret them in a climate/weather sense as best as you can (e.g., do you see resolve features that are known? Do the time series have any periodicity you can see by eye? Or do they have trends?). You might find it useful to plot the variance of wintertime 1000 mb heights as a comparison. Compare your EOFs to plots shown in Quadrelli and Wallace (2004). How do your maps compare to the SLP EOFs/PCs in their paper?