AT655
Objective Analysis in the Atmospheric Sciences
Spring 2007

Instructor:
David W. J. Thompson
Room 430, Atmospheric Science
(970) 491-3338
davet@atmos.colostate.edu

TA (s):
Amy Butler
amy@atmos.colostate.edu

Office hours:
TBD

Meeting times:
Tuesday, Thursday 11:00-12:15 PM, Room AT101

Course credits:
3

Course website:
www.atmos.colostate.edu/~davet/AT655

Textbook/notes:
We will frequently use notes provided courtesy of Professors Dennis Hartmann and John M. Wallace (Department of Atmospheric Sciences, University of Washington). We will also draw from the following texts (texts are on reserve in the library. They are recommended, but not required):
Statistical Analysis in Climate Research. von Storch and Zwiers, Cambridge U. Press, 1999
Statistical Methods in the Atmospheric Sciences Wilks, Academic Press, 1995
Schaum's Outline Series: Statistics Murray R. Spiegel McGraw-Hill.

Objective:
The course provides an overview of the statistical methods used to interpret data sets in the atmospheric and oceanic sciences. This is a tools class: the objective is to provide a working knowledge of the statistical tools most commonly used in the literature. Emphasis is placed on the application of the tools discussed in class to the analysis of atmospheric data. Topics include the application of basic statistics (superposed epoch analysis; significance testing; curve fitting; correlation and regression theory), matrix methods (principal component analysis; SVD analysis; CCA), and time series analysis (harmonic analysis; power spectra; filtering; cross-spectrum analysis; SSA; wavelet analysis).

Course outline:
1. Review and application of elementary statistics.
• Review of basic statistics.
• Correlation theory; regression; multiple-regression; sampling theory of correlation.
• Superposed epoch analysis.
• Application of basic statistics to data sets.

2. Matrix methods.
• Review of linear algebra; vector spaces; rank; orthogonalization
• Matrix decomposition; singular value decomposition (SVD)
• Application of SVD to data compression and filtering
• Empirical orthogonal functions; principal-component analysis
• SVD analysis; canonical correlation analysis (CCA)
• Rotated EOF analysis
• POP analysis
• Application of EOF, SVD, CCA, and POP to atmospheric data
3. Time series analysis
• Autocorrelation; red noise white noise
• Harmonic analysis; power spectra; methods of computing power spectra
• Significance testing of spectral peaks; data windows
• Cross spectrum analysis
• Filtering; filter design; recursive/nonrecursive filters; response functions
• Singular spectrum analysis
• Wavelet analysis
• Application of time series analysis to atmospheric wave phenomena

Grading and exams:
70% of the grade is based on ~7 homework assignments which emphasize the application of the tools discussed in class to observational data. The remaining 30% of the grade is based on a term project of the student's design. Term project proposals are due by late March, and term projects are due the last class of the semester. Project writeups should include a brief introduction/motivation, a synopsis of the methodology, a clear discussion of the results, and a summary/discussion. But conciseness is key: writeups should be no longer than two pages single spaced text and 6 figures.

Note that the homework requires access to analysis and plotting software (e.g., IDL, Matlab, Fortran, Grads, etc), and that the data sets are available through the class website in ASCII format. There are no exams.