Department of Atmospheric Sciences

COURSE ANNOUNCEMENT – SEMESTER I – 2005–2006

ATMS 502: Numerical Fluid Dynamics
(Same as CS 505, CSE 566)

Call number:	37123
Instructor:	Prof. Brian Jewett, 212 Atmos. Sci. Bldg., 333-3957
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Room and Time:	109 Atmospheric Science Bldg., 9:00 – 9:50 M W F
Credit:	4 hours
Prerequisites:	Math 380 or consent of instructor

FOR: This course is for those interested in numerically solving partial differential equations in either compressible or incompressible form that describe subsonic fluid flow, including those desiring to implement these techniques on high performance computers such as those at the National Center for Supercomputing Applications (NCSA) at the University of Illinois.

COURSE OVERVIEW: The course focuses on the use of finite difference methods in solving wave equations. Content is directed at providing an understanding of how some of the classic and newer finite difference methods affect the solution of advection and Burger's equations. Topics include time and space approximations, use of staggered meshes, explicit/semi-implicit/implicit formulations, time-splitting, use of fractional steps, monotonicity, positive definiteness, and flux limiting. Extensions to nonlinear systems including the shallow-water and Euler equations and to tracer transport are then presented. Throughout the course, theoretical numerical principles such as stability, accuracy, convergence, and aliasing are introduced without formal mathematical theorems and proofs and are then related to the behavior of different numerical approximations.

COMPUTER PROBLEMS: Emphasis is placed on the use of high-speed computers to numerically solve increasingly complex fluid flow systems. Techniques for writing codes will be presented, including the structuring of codes for efficient use of parallel computers. The behavior of the different systems is explored in relation to known solutions when they are available.

TEXT: *Numerical Methods for Wave Equations in Geophysical Fluid Dynamics,* by Dale Durran, Springer-Verlag New York, Inc., 1999. (Required)