cal geometry. The shallow water equations exhibit the major difficulties associated with the horizontal dynamical aspects of atmospheric modeling on the spherical earth. These cases are designed for use in the evaluation of numerical methods proposed for climate modeling and to identify the potential trade-offs which must always be made in numerical modeling. Before a proposed scheme is applied to a full baroclinic atmospheric model it must perform well on these problems in comparison with other currently accepted numerical methods. The cases are presented in order of complexity. They consist of advection across the poles, steady state geostrophically balanced flow of both global and local scales, forced nonlinear advection of an isolated low, zonal flow impinging on an isolated mountain, Rossby–Haurwitz waves, and observed atmospheric states. One of the cases is also identified as a computer performance/algorithm efficiency benchmark for assessing the performance of algorithms adapted to massively parallel computers.

A SUBCELL RESOLUTION METHOD FOR VISCOUS SYSTEMS OF CONSERVATION LAWS. Eduard Harabetian. *Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109.*

We consider the generalization of scalar subcell resolution schemes to systems of viscous conservation laws. For this purpose we use a weakly nonlinear geometrical optics approximation for parabolic perturbations of hyperbolic conservation laws and the Roe type field by field decomposition. Computations of the reactive Navier–Stokes equations are presented as an application.

AN ALGORITHM FOR DECONVOLUTION BY THE MAXIMUM ENTROPY METHOD WITH ASTRONOMICAL APPLICATIONS. Johann Reiter. *Mathematisches Institut der Technischen Universität München, Arcisstraße 21, D-8000 München 2, Germany.*

The solution of a Fredholm integral equation of the first kind, which is, in general, an ill-posed problem, can be regularized by the maximum entropy method (MEM). With this method the solution is reformulated as a nonlinear optimization problem with one or two nonlinear constraints. In real life applications, however, this optimization problem is a large-scale one with up to 10^6 unknowns to be determined. For the solution of such problems we present a numerical algorithm which is made to work most efficiently on modern multiprocessor, vector computers. The usefulness of the algorithm is illustrated by deconvolving optical pictures of the sky taken with astronomical telescopes.

EXTRACTION OF ACCURATE FREQUENCIES FROM THE FAST-FOURIER-TRANSFORM SPECTRA. Kazuo Takatsuka. *Department of Chemistry, College of General Education, Nagoya University, Nagoya 464-01, Japan.*

The Fast Fourier Transformation (FFT) is well-known to be extremely fast and useful. However, its spectrum is quite often not accurate, because it is a discrete transformation and, further, the effect of finite range of sampling, the so-called Gibbs phenomenon, produces long tails. Here a very simple and efficient method to extract the accurate frequencies and the amplitudes of discrete spectra from FFT data is proposed. No window function is used in the present method. Indeed, our numerical examples show that the resultant frequencies and amplitudes are extremely accurate.

A SPECTRAL METHOD FOR THE NUMERICAL SOLUTIONS OF A KINETIC EQUATION DESCRIBING THE DISPERSION OF SMALL PARTICLES IN A TURBULENT FLOW. Tao Tang and S. McKee. *Department of Mathematics, University of Strathclyde, Glasgow G1 1XH, Scotland*; M. W. Reeks. *Nuclear Electric plc., Berkeley Nuclear Laboratories, Berkeley, Gloucestershire GL13 9PB, England.*

In this paper we consider numerical solutions to a kinetic equation for the dispersion of small particles in a turbulent flow. The solution represents the probability density that a particle has a certain velocity and position at a given time. These solutions are based on a mixed finite-difference-spectral method. Computational results are presented.

AN ALGORITHM FOR TRACKING FLUID PARTICLES IN A SPECTRAL SIMULATION OF TURBULENT CHANNEL FLOW. K. Kontomaris and T. J. Hanratty. *Department of Chemical Engineering, University of Illinois, Urbana, Illinois 61801*; J. B. McLaughlin. *Department of Chemical Engineering, Clarkson University, Potsdam, New York 13676.*

The ability to follow individual fluid particles dispersing in a turbulent flow and to collect turbulence information along their trajectories is of key importance in many problems of practical and theoretical significance. With the availability of a direct numerical simulation of turbulence such information can be extracted directly from first principles without resorting to questionable assumptions. In this paper an algorithm for tracking fluid particles in a direct numerical simulation of turbulent channel flow is developed and tested. Fluid particle velocities are computed with an interpolation scheme that employs Lagrange polynomials of order 6 in the homogeneous directions of the channel and Chebyshev polynomials in the inhomogeneous normal direction. Errors in computed particle velocities and trajectories are assessed and it is shown that accurate single-particle Lagrangian statistics can be extracted both in the center and in the wall region of the channel.

A FAST ALGORITHM FOR CHEBYSHEV, FOURIER, AND SINC INTERPOLATION ONTO AN IRREGULAR GRID. John P. Boyd. *Department of Atmospheric, Oceanic & Space Sciences, and Laboratory for Scientific Computation, University of Michigan, 2455 Hayward Avenue, Ann Arbor, Michigan 48109.*

A Chebyshev or Fourier series may be evaluated on the standard collocation grid by the fast Fourier transform (FFT). Unfortunately, the FFT does not apply when one needs to sum a spectral series at N points which are spaced *irregularly*. The cost becomes $O(N^2)$ operations instead of the FFT's $O(N \log N)$. This sort of "off-grid" interpolation is needed by codes which dynamically readjust the grid every few time steps to resolve a shock wave or other narrow features. It is even more crucial to semi-Lagrangian spectral algorithms for solving convection–diffusion and Navier–Stokes problems because off-grid interpolation must be performed several times per time step. In this work, we describe an alternative algorithm. The first step is to pad the set of spectral coefficients $\{a_n\}$ with zeros and then take an FFT of length $3N$ to interpolate the Chebyshev series to a very fine grid. The second step is to apply either the Mth order Euler sum acceleration or $(2M+1)$-point Lagrangian interpolation to approximate the sum of the series on the irregular grid. We show that both methods yield full precision with $M \ll N$, allowing an order of magnitude reduction in cost with no loss of accuracy.

GLOBAL OPTIMIZATION METHODS FOR HIGHLY MULTIMODAL INVERSE PROBLEMS. John A. Scales, Martin L. Smith, and Terri L. Fischer. *Amoco Research Center, P.O. Box 3385, Tulsa, Oklahoma 74102.*

Global optimization methods such as simulated annealing and genetic algorithms are potentially useful in attacking the multimodal search calculations which arise in a number of geophysical inverse problems. In the one-dimensional waveform inversion problem considered here the optimization method must find a one-dimensional earth structure which produces a seismogram that agrees with an observed seismogram. Both