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Abstracts of Papers to Appear

Development of a High-Resolution Nested Air Pollution Model. The Numerical Approach. Lise M. Frohn, Jesper H. Christensen, and Jørgen Brandt. Department of Atmospheric Environment, National Environmental Research Institute, P.O. Box 358, Frederiksborgvej 399, DK-4000 Roskilde, Denmark.

A new 3-D model regional high-resolution air pollution model is under development at the National Environmental Research Institute (NERI). The model is based on models developed over the past decades at NERI. The goal is to obtain a nested model capable of high-resolution operation. To reach this goal it is necessary to implement sufficiently accurate numerical methods. The model will be applied to studying air pollution phenomena (monitoring, forecasting, and scenarios) over Denmark. In the present paper, the outline of the new model is presented. The numerical methods for transport and chemistry are described. The horizontal transport in the model is solved using an accurate space derivatives algorithm. This method traditionally requires periodic boundary conditions, which are not applicable for nested modeling. Therefore a new method for calculating nonperiodic boundary conditions has been developed. The numerical solution to the chemistry part of the model is obtained from an implementation of a new combination of two existing numerical methods. The results from extensive testing of the numerical solution of the advection and the coupling of the solution of advection and chemistry in the model using Molenkamp–Crowley rotation tests are presented. The same tests have been applied to the model with and without nesting. The results show that the numerical methods are suitable for modeling air pollution levels at high resolution.

Numerical Analysis of the Isotropic Fokker–Planck–Landau Equation. C. Buet* and S. Cordier.† *Commissariat à l'Énergie Atomique, 91680 Bruyères-le-Châtel, France; and †MAPMO, UMR 6628, Université d'Orléans, B.P. 6759, 45072 Orléans, France.

The homogeneous Fokker–Planck–Landau equation is investigated for Coulombic potential and isotropic distribution function, i.e., when the distribution function depends only on time and on the modulus of the velocity. We derive a conservative and entropy decaying semidiscretized Landau equation for which we prove the existence of global in-time positive solutions. This scheme is not based on the so-called "Landau–Log" formulation of the operator and ensures the physically relevant long-time behavior of the solution.

Lattice Kinetic Schemes for Magnetohydrodynamics. Paul J. Dellar. Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Silver Street, Cambridge CB3 9EW, United Kingdom.

Lattice kinetic equations for simulating incompressible magnetohydrodynamics in two or three dimensions are constructed. The fluid is simulated via a conventional low Mach number lattice Boltzmann scheme, modified to include the Lorentz force due to the magnetic field. The magnetic field is represented by a separate vector-valued magnetic distribution function which obeys a vector Boltzmann–BGK equation. The two distribution functions are only coupled via the macroscopic density, momentum, and magnetic field evaluated at lattice points. This allows a reduced lattice to be used for the magnetic distribution function, with a corresponding saving in storage, which becomes comparable to that for the scalar hydrodynamic distribution function. The magnetic diffusivity may be adjusted independently of the fluid viscosity, unlike an earlier formulation. Numerical experiments with Hartmann flow, the Orszag–Tang vortex, and the doubly periodic coalescence instability compare favorably with results obtained using a spectral method, and with previously published results. The scheme preserved a consistent approximation to the divergence-free condition $\nabla \cdot \mathbf{B} = 0$ to round-off error.

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A Fast Semi-implicit Finite-Difference Method for the TDGL Equations. T. Winiecki and C. S. Adams. Department of Physics, University of Durham, Rochester Building, South Road, Durham, DH1 3LE, United Kingdom.

We propose a finite-difference algorithm for solving the time-dependent Ginzburg–Landau (TDGL) equation coupled to the appropriate Maxwell equation. The time derivatives are discretized using a second-order semi-implicit scheme which, for intermediate values of the Ginzburg–Landau parameter κ, allows time steps two orders of magnitude larger than commonly used in explicit schemes. We demonstrate the use of the method by solving a fully three-dimensional problem of a current-carrying wire with longitudinal and transverse magnetic fields.

The Use of Domain Decomposition in Accelerating the Convergence of Quasihyperbolic Systems. Bernard Parent and Jean P. Sislian. University of Toronto Institute for Aerospace Studies, 4925 Dufferin St., Downsview, Ontario M3H 5T6, Canada.

This paper proposes an alternate form of the active-domain method [K. Nakahashi and E. Saitoh, *AIAA J.* **35**, 1280 (1997)] that is applicable to streamwise separated flows. Named the "marching window," the algorithm consists of performing pseudo-time iterations on a minimal width subdomain composed of a sequence of cross-stream planes of nodes. The upstream boundary of the subdomain is positioned such that all nodes upstream exhibit a residual smaller than the user-specified convergence threshold. The advancement of the downstream boundary follows the advancement of the upstream boundary, except in zones of significant streamwise ellipticity, where a streamwise ellipticity sensor ensures its continuous progress. Compared to the standard pseudo-time-marching approach, the marching window decreases the work required for convergence by up to 24 times for flows with little streamwise ellipticity and by up to eight times for flows with large streamwise separated regions. Storage is reduced by up to six times by not allocating memory to the nodes not included in the computational subdomain. The marching window satisfies the same convergence criterion as the standard pseudotime-stepping methods, hence resulting in the same converged solution within the tolerance of the user-specified convergence threshold. The algorithm is not restricted to a discretization stencil and pseudo-time-stepping scheme in particular and is used here with the Yee–Roe scheme and block-implicit approximate factorization solving the Favre-averaged Navier–Stokes (FANS) equations closed by the Wilcox $k\omega$ turbulence model. The eigenstructure of the FANS equations is also presented.