McGill Computational Science and Engineering Seminar

Friday November 24th at 14:00 in Burnside Hall room 1205

Spectral Element Methods for Atmospheric General Circulation Models

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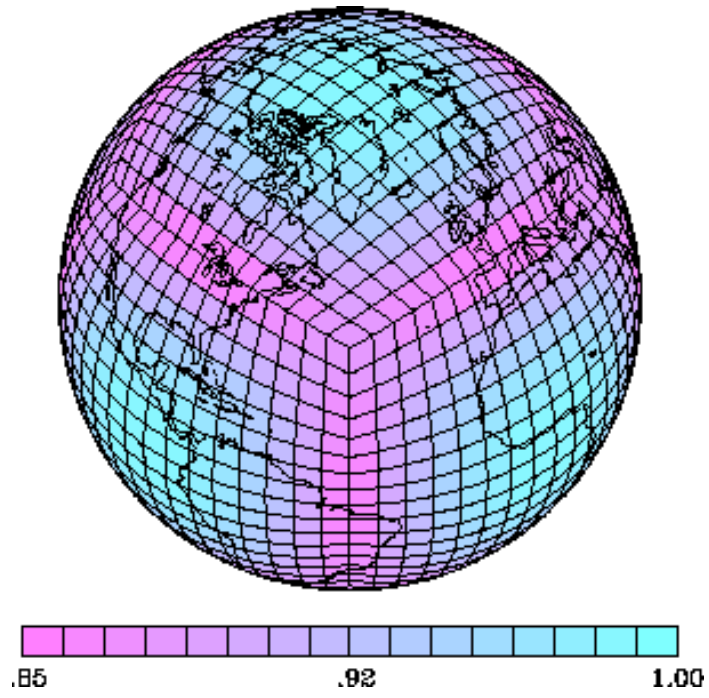
Spectral element methods combine the accuracy and exponential convergence of conventional spectral methods with the geometric flexibility of finite element methods. Additionally, there are several apparent computational advantages to using spectral element methods on RISC microprocessors. In particular, the computations are naturally cache-blocked and derivatives may be computed using nearest neighbor communications. Thus, an explicit spectral element atmospheric model has demonstrated close to linear scaling on a variety of distributed memory computers including IBM SP-2's and Linux Clusters. Explicit formulations of PDE's arising in geophysical fluid dynamics, such as the primitive equations on the sphere, are time-step limited by the phase speed of gravity waves. Semi-implicit time integration schemes remove the stability restriction but require the solution of an elliptic BVP. By employing a weak formulation of the governing equations, it is possible to obtain a symmetric Helmholtz operator that permits the solution of the implicit problem using an efficient conjugate gradient solver. The solver is preconditioned using either deflation or Schwarz domain decomposition. This approach accelerates the simulation rate of the semi-implicit model relative to the explicit model for practical climate resolutions.



Coffee and desserts are served after the seminar at 15:00 in the lounge, Burnside Hall 1024