Geophysical Research Abstracts
Vol. 16, EGU2014-16501-1, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

GPU Developments for General Circulation Models

Jeremy Appleyard (1), Stan Posey (2), Carl Ponder (3), and Joe Eaton (3)
(1) NVIDIA, United Kingdom, (2) NVIDIA Corporation, Santa Clara, CA, USA (sposey@nvidia.com), (3) NVIDIA Corporation, Austin, TX, USA

Current trends in high performance computing (HPC) are moving towards the use of graphics processing units (GPUs) to achieve speedups through the extraction of fine-grain parallelism of application software. GPUs have been developed exclusively for computational tasks as massively-parallel co-processors to the CPU, and during 2013 an extensive set of new HPC architectural features were developed in a 4th generation of NVIDIA GPUs that provide further opportunities for GPU acceleration of general circulation models used in climate science and numerical weather prediction.

Today computational efficiency and simulation turnaround time continue to be important factors behind scientific decisions to develop models at higher resolutions and deploy increased use of ensembles. This presentation will examine the current state of GPU parallel developments for stencil based numerical operations typical of dynamical cores, and introduce new GPU-based implicit iterative schemes with GPU parallel preconditioning and linear solvers based on ILU, Krylov methods, and multigrid.

Several GCMs show substantial gain in parallel efficiency from second-level fine-grain parallelism under first-level distributed memory parallel through a hybrid parallel implementation. Examples are provided relevant to science-scale HPC practice of CPU-GPU system configurations based on model resolution requirements of a particular simulation. Performance results compare use of the latest conventional CPUs with and without GPU acceleration. Finally a forward looking discussion is provided on the roadmap of GPU hardware, software, tools, and programmability for GCM development.