Accelerating Climate Simulations Through Hybrid Computing

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Unconventional multi-core processors (e.g., IBM Cell B/E and NVIDIDA GPU) have emerged as accelerators in climate simulation. However, climate models typically run on parallel computers with conventional processors (e.g., Intel and AMD) using MPI. Connecting accelerators to this architecture efficiently and easily becomes a critical issue. When using MPI for connection, we identified two challenges: (1) identical MPI implementation is required in both systems, and; (2) existing MPI code must be modified to accommodate the accelerators. In response, we have extended and deployed IBM Dynamic Application Virtualization (DAV) in a hybrid computing prototype system (one blade with two Intel quad-core processors, two IBM QS22 Cell blades, connected with Infiniband), allowing for seamlessly offloading compute-intensive functions to remote, heterogeneous accelerators in a scalable, load-balanced manner. Currently, a climate solar radiation model running with multiple MPI processes has been offloaded to multiple Cell blades with ~10% network overhead.