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High Performance Computing in Solid Earth Sciences

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Presently, the solid earth sciences started to move towards implementing high performance computational (HPC) research facilities. One of the key tenants of HPC is performance, and designing a HPC solution tailored to a specific research field as solid earth that represents an optimum price/performance ratio is often a challenge. The HPC system performance strongly depends on the software-hardware interaction, and therefore prior knowledge on how well specific parallelized software performs on different HPC architectures can weight significantly on choosing the final configuration. In this paper we present benchmark results from two different HPC systems: one low-end HPCC (Horus) with 300 cores and 1.6 TFlops theoretical peak performance, and one high-end HPCC (CyberDyn) with 1344 cores and 11.2 TFlops theoretical peak performance. The software benchmark used in this paper is the open source package CitcomS, which is widely used in the solid earth community (www.geodynamics.org). Testing a CFD code specific for earth sciences, the HPC system Horus based on Gigabit Ethernet performed remarkably well compared with its counterpart Cyeberdyn which is based on Infiniband QDR fabric, but only for a relatively small number of computing cores (96). However, increasing the mesh size and the number of computing cores the HPCC CyberDyn starts outperforming the HPCC Horus because of the low-latency high-speed QDR network dedicated to MPI traffic. Since presently we are moving towards high-resolution simulations for geodynamic predictions that require the same scale as observations, HPC facilities used in earth sciences should benefit from larger up-front investment in future systems that are based on high-speed interconnects.