Global seismic wave computation on the K computer

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We present high-performance simulations of global seismic wave propagation with an unprecedented accuracy of 1.2 seconds seismic period for a realistic three-dimensional Earth model by using the Spectral-Element Method on the K computer. Our seismic simulations use a total of 665.2 billion grid points and resolve
1.8 trillion degrees of freedom. To realize these large-scale computations, we optimize a widely used community software code to efficiently address all hardware parallelization, especially thread-level parallelization to solve the bottleneck of memory usage for coarse-grained parallelization. The new code exhibits excellent strong scaling for the time stepping loop, i.e. parallel efficiency on 82,134 nodes relative to 36,504 nodes is 99.54%. Sustained performance of these computations on the K computer is 1.24 petaflops, which is 11.84% of its peak performance. The obtained seismograms with an accuracy of 1.2 seconds for the entire globe should help us to better understand rupture mechanisms of devastating earthquakes.
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