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SPECTRAL-ELEMENT SIMULATIONS OF THE NOVEMBER 3, 2002, DENALI, ALASKA, EARTHQUAKE USING THE EARTHSIMULATOR

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Progress in global seismology is to a large extent due to the tremendous growth in seismic data acquisition, particularly with the worldwide deployment of digital broadband networks over the past two decades. Based upon this wealth of data, models of shear and compressional velocity heterogeneity, anisotropy, and attenuation have provided important constraints on the Earth's composition and physical processes. The recently developed spectral-element method enables us to accurately simulate global seismic wave propagation in three-dimensional models of the Earth without intrinsic restrictions on the level of heterogeneity or the frequency content. The method accounts for effects due to lateral heterogeneity, anisotropy, attenuation, variable crustal thickness, topography, ellipticity, rotation, and self-gravitation. We review the development of the method and present seismograms that illustrate the sometimes profound waveform complications due to three-dimensional heterogeneity.

Detailed modeling of the rupture process of large earthquakes requires the ability to simulate global seismic wave propagation in three-dimensional Earth models at relatively short periods (5 seconds and greater). We use the EarthSimulator at JAMSTEC in Yokohama, Japan to simulate seismic waves generated by the $\mathbf{M}_w = 7.9$ November 3, 2002, Denali, Alaska, earthquake. The EarthSimulator has 640 nodes, each consisting of eight vector processors with 16 Gigabytes of memory. Total measured sustained LINPACK performance is 35 Teraflops on the new Top500 list of supercomputers, on which the Earth Simulator ranks #1, and the total amount of memory is 10,000 Gigabytes. This machine allows us to reach unprecedented resolution and simulate seismograms in the full 3-D Earth down to a minimum period of 5 seconds.