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The effects of three-dimensional heterogeneous Earth model of coseismic displacement changes of the Sumatra earthquake of 26 December 2004

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The 26 December 2004 Sumatra-Andaman earthquake with moment magnitude (Mw) of 9.1 to 9.3 is the first great earthquake recorded by digital broadband, high-dynamic-range seismometers and global positioning system (GPS) equipment, which recorded many high-quality geophysical data sets. The spherical curvature is not negligible in far field especially for large event and the real Earth is laterally inhomogeneity and the analytical results still are difficult to explain the geodetic measurements. We use equivalent body force finite elements method Zhang et al. (2015) and mesh the whole earth, to compute global co-seismic displacements using four fault slip models of the 2004 Sumatra earthquake provided by different authors. Comparisons of calculated co-seismic displacements and GPS show that the confidences are well in near field for four models, and the confidences are according to different models. In the whole four models, the Chlieh model (Chlieh et al., 2007) is the best as this slip model not only accord well with near field data but also far field data.

And then we use the best slip model, Chlieh model to explore influence of three dimensional lateral earth structure on both layered spherically symmetric (PREM) and real 3-D heterogeneous earth model (Crust 1.0 model and GyPSuM). Results show that the effects of 3-D heterogeneous earth model are not negligible and decrease concomitantly with increasing distance from the epicenter. The relative effects of 3-D crust model are 23% and 40% for horizontal and vertical displacements, respectively. The effects of the 3-D mantle model are much smaller than that of 3-D crust model but with wider impacting area.