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LLNL-G3Dv3: Global P-wave tomography model for improved regional and teleseismic travel time prediction

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We develop a global-scale P-wave velocity model (LLNL-G3Dv3) designed to accurately predict seismic travel times at regional and teleseismic distances simultaneously. The model provides a new image of Earth's interior, but the underlying practical purpose of the model is to provide enhanced seismic event location capabilities. The LLNL-G3Dv3 model is based on ∼2.8 million P and Pn arrivals that are re-processed using our global multiple-event locator called Bayesloc. We construct LLNL-G3Dv3 within a spherical tessellation based framework, allowing for explicit representation of undulating and discontinuous layers including the crust and transition zone layers. Using a multi-scale inversion technique, regional trends as well as fine details are captured where the data allow. LLNL-G3Dv3 exhibits large-scale structures including cratons and superplumes as well numerous complex details in the upper mantle including within the transition zone. Particularly, the model reveals new details of a vast network of subducted slabs trapped within the transition beneath much of Eurasia, including beneath the Tibetan Plateau. We demonstrate the impact of Bayesloc multiple-event location on the resulting tomographic images through comparison with images produced without the benefit of multiple-event constraints (single-event locations). We find that the multiple-event locations allow for better reconciliation of the large set of direct P phases recorded at 0-97° distance and yield a smoother and more continuous image relative to the single-event locations. Travel times predicted from a 3-D model are also found to be strongly influenced by the initial locations of the input data, even when an iterative inversion/relocation technique is employed. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-ABS-559093