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Global-scale Seismic Tomography with a P and Pn data set

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We are developing a global tomography model of the mantle and crust in order to accurately predict travel times for P-wave arrivals at both teleseismic and regional distances. We explicitly represent undulating and discontinuous velocity discontinuities such as the Moho and other crustal units. We have developed a modeling framework that allows for direct representation of such surfaces while facilitating rapid model referencing. Three-dimensional ray tracing is used to achieve the highest level of travel time prediction accuracy. The model space is parameterized with sets of nodes that define a triangular tessellation on a spherical surface. The tessellation-based model architecture is hierarchical in that fine node sampling is achieved by recursively subdividing a base-level tessellation. Determining the required node spacing to effectively model a given set of data is problematic, given the covariant nature of seismic data and the differing wavelengths of actual seismic heterogeneity. With this in mind, we have developed an inversion process called Progressive Multi-tier Tessellation Inversion (PMTI) that takes advantage of the hierarchical nature of the tessellation-based design. PMTI allows the data to drive model resolution by progressively solving for shorter wavelength structure, thereby robustly imaging regional trends and allowing details to emerge where resolution is sufficient. Using the PMTI approach, we have developed a global-scale P-wave model that simultaneously predicts teleseismic P wave arrivals and regional seismic arrivals throughout the Middle East. Prepared by LLNL under Contract DE-AC52-07NA27344. LLNL abstract