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A Global 3D P-Velocity Model of the Earth's Crust and Mantle for Improved Seismic Event Location

To test the hypothesis that high quality 3D Earth models will produce seismic event locations that are more accurate and more precise than currently used 1D and 2.5D models, we are developing a global 3D P wave velocity model of the Earth's crust and mantle using seismic tomography. In this paper, we present the most recent version of SALSA3D and demonstrate its ability to reduce mislocations for a large set of realizations derived from a carefully chosen set of globally-distributed ground truth events. We obtain path-dependent travel time prediction uncertainties for our model by computing the full 3D model covariance matrix of our tomographic system and integrating the model slowness variance and covariance along paths of interest. This approach yields very low travel time prediction uncertainties for well-sampled paths through the Earth and higher uncertainties for paths that are poorly represented in the data set used to develop the model. While the calculation of path-dependent prediction uncertainties with this approach is computationally expensive, uncertainties can be pre-computed for a network of stations and stored in 3D lookup tables that can be quickly and efficiently interrogated using GeoTess software.

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