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SPiRaL 1.0: Global tomography model of travel times and surface waves with transversely isotropic crust and mantle

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SPiRaL version 1.0 is a global-scale joint image of shear and compressional wave speeds derived from millions of travel time arrivals and global surface wave dispersion estimates for Rayleigh and Love waves. We incorporate several modeling elements used to construct the previous LLNL-G3D series of models (Simmons et al. 2011; 2012; 2015) including multiple-event relocation procedures, multi-resolution imaging with spherical tessellation hierarchies, joint inversion with mineral physics constraints and 3-D ray tracing for P- and S-wave phases at regional and teleseismic distances. The new model also incorporates surface wave dispersion estimates for Rayleigh and Love group and phase velocities from recent surface wave maps spanning periods from 25 to 200 seconds (Ma et al. 2014; Ma and Masters 2014). The SPiRaL model consists of over 1.7 million nodes with 5 modeled values at each node including Vp, Vs, and 3 parameters needed to fully account for transverse isotropy for P-, Sh-, and Sv-waves at any arbitrary direction of travel. The bulk (average) strength of anisotropy in the upper mantle is consistent with past waveform- and surface-wave based studies, however there is an indication that the radial anisotropy in the transition zone might be stronger than previously realized. The SPiRaL model represents a significant step towards a global-scale model, with regional-scale details, that can predict multiple seismic observables significant to seismic monitoring including accurate travel times at all distances as well as waveform features important to source characterization.

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