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Multi-mode surface wave tomography of the North American upper mantle: 3-D shear wave speed model and radial anisotropy

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The three dimensional shear wave speed structure and radial anisotropy of the upper mantle beneath the North American continent is investigated from automatic measurements of multi-mode phase speeds of Love and Rayleigh waves. We have employed a fully automated method of a nonlinear waveform fitting based on a direct model-parameter search with the neighbourhood algorithm (Yoshizawa and Kennett, 2002a GJI). This method has been applied to long-period three-component records of seismic stations in North America, which mostly comprise the GSN and US regional networks including USArray stations distributed by the IRIS DMC. We have collected over 30,000 path-specific phase speeds of fundamental-mode and higher-mode surface waves in the period range from 30 to 200 seconds. These path-specific phase speeds are then inverted for multi-mode phase speed maps incorporating approximate effects of finite-frequency via the surface-wave influence zone (Yoshizawa and Kennett, 2002b GJI, 2004 JGR), within which surface waves are assumed to be coherent in phase. A 3-D radially anisotropic shear wave speed model is obtained from simultaneous inversions of local dispersion curves of both Love and Rayleigh waves. The preliminary high-resolution 3-D model of North America indicates a large-scale strong velocity contrast between the western and central United States with slow anomalies beneath the Rocky Mountain Range down to 150 km depth and fast anomalies beneath the cratonic areas. Radial anisotropy model shows fast anomalies of vertically polarized shear waves (SV waves) relative to horizontally polarized shear waves (SH waves) beneath the Cascade Range volcanoes down to about 70-100 km, and a similar anomaly beneath the Yellowstone hotspot seems to persist down to about 200-250 km.