Simultaneous Inversion of Interpolated Receiver Functions, Surface-wave Dispersion, and Gravity Observations for Lithospheric Structure Beneath the Western and Eastern United States

Chengping Chai[1], Charles J. Ammon[1], Monica Maceira[2], Robert Herrmann[3]

1. Department of Geosciences, Pennsylvania State University, University Park, PA
2. Los Alamos National Laboratory, Los Alamos, NM
3. Department of Earth & Atmospheric Sciences, Saint Louis University, St. Louis, MO

As Earthscope's Transportable Array moves out of the east coast region, the unprecedented high-quality seismic data provide a great opportunity to investigate the subsurface structure beneath the region. Estimates of the lithospheric structure have been produced by integrating multiple observations. Though the combination of receiver functions and surface-wave dispersion is ideal for vertical resolution, the sensitivity difference is not ideal when we look at how each signal averages the lateral structure. We have developed a receiver-function wavefield interpolation/smoothing method to equalize the lateral sampling of the receiver functions and the surface-wave dispersion, and to greatly simplify the receiver functions (Chai et al, GRL, 2015). Time slices (see figure below) at time 3.2 s from the receiver-function wavefield in the eastern US show that the receiver-function interpolation reduces scattering effects and extracts the spatially coherent signal. The interpolated receiver functions are combined with Rayleigh-wave dispersion and gravity observations to estimate the 3D shear speed beneath the regions. We use a hybrid 3D, multi-objective inversion that provides more constraints than individual inversions. The subsurface model is parameterized with shear-wave speed. P-wave velocities and density variations are related to shear-speed using empirical velocity ratios and relations. Preliminary results show low speeds associated with major basins and first-order structural features consistent with previous studies. The model corroborates and extends our knowledge of the subsurface. Receiver-function animation is a vivid way for students to explore the effect of geology on seismic data.