Wave Gradiometry for USArray

Yuanyuan liu William Holt

Wave gradiometry is a new technique utilizing the shape of seismic wave fields captured by USArray to determine fundamental wave propagation characteristics. The horizontal and vertical wave displacements, spatial gradients and time derivatives of displacement are linearly linked by two coefficients which can be used to infer wave slowness, back azimuth, radiation pattern and geometrical spreading. We use the reducing velocity method of Liang and Langston [2008] and spatial gradients of the shifted displacement fields are estimated using bi-cubic splines. These spatial gradients are then inverted to iteratively solve for the four wave parameters at each station. Numerical experiments using synthetic data sets [provided by Princeton University's Neal Real Time Global Seismicity Portal] are conducted to test the algorithm stability and evaluate errors. The derived average phase velocities for Rayleigh waves in the 100 – 125 s period window, from four different earthquakes, range from 3.95 to 4.25 km/s in the west part of North America (Figure 1), which is consistent with earth models. Further effort will be made on formulating formal errors in the wave parameters, given estimates of station amplitude uncertainties. The wave gradiometry method is now being employed across the USArray using real observations (Rayleigh waves) and results obtained to date are for stations in central portion of the U.S.

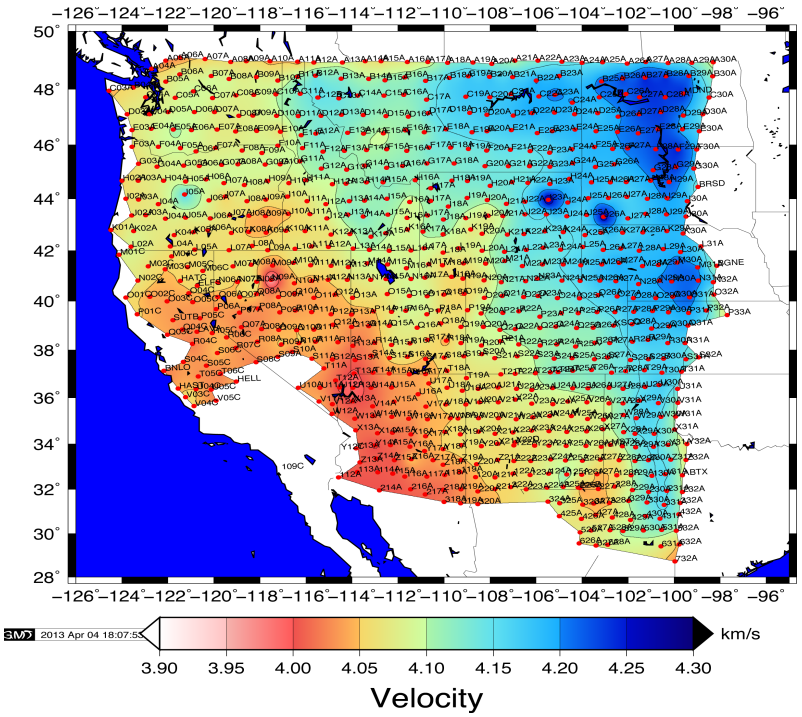

Figure 1 Average Rayleigh wave phase velocity distribution map determined from synthetic waveforms for four earthquakes (Turkey, 23 Oct 2011; Vanuatu islands, 25 Dec 2010; Coast of Chile, 02 Jan 2011; Ryukyu islands, 26 Feb 2010) using wave gradiometry method. Red dots denote USArray seismic stations.