Rayleigh-wave ellipticity obtained from noise cross-correlations across southern California

E. M. Berg¹, F.-C. Lin¹, A. A. Allam¹

¹University of Utah, Department of Geology & Geophysics, e.m.berg@utah.edu; FanChi.Lin@utah.edu

We analyze Rayleigh wave ellipticity, or Rayleigh wave H/V (horizontal to vertical) amplitude ratios, computed from multi-component ambient noise cross-correlations using over 300 stations throughout Southern California in 2015. Because Rayleigh wave H/V ratios are sensitive to shallow local earth structure, this method enables simple and accurate resolution of near-surface geological features. For every station pair, we simultaneously calculate the cross-correlation function in 1-day time windows that are then stacked for all of 2015. Pre-processing includes concurrent three-component temporal normalization and spectral whitening in order to dependably preserve amplitude information. Retaining correlation functions with signal-to-noise ratios greater than five and two to three wavelengths distance depending on period, we then measure amplitude ratios between cross-correlations of different components (radial-radial, radial-vertical, vertical-radial, vertical-vertical) to determine Rayleigh wave H/V ratios at the two station locations for each source-receiver noise cross-correlation pair. The ratio between the radial-radial and vertical-radial components (or radial-vertical and vertical-vertical) corresponds to the H/V ratio of the source station while the ratio between radial-radial and radial-vertical (or vertical-radial and vertical-vertical) corresponds to the receiver station. For a given station, we then compute the mean and the standard deviation of the mean for all such measurements using every viable station pair, yielding a single representative H/V ratio and its uncertainty for that station. Our final maps of H/V ratios show relatively good correspondence with known near-surface structure with a few non-corresponding locations, motivating further study. High ratios are observed in the LA Basin, Santa Barbara Basin, and Salton Trough, while low ratios are noted in the San Gabriel, San Jacinto and southern Sierra Nevada mountains. Unusually high ratios seen in the southern Coast Ranges and Eastern California Shear Zone may represent extremely local shallow sedimentary features.