

Offshore structure of the Cascadia subduction zone from full-wave ambient noise tomography

Haiying Gao and Yang Shen

University of Rhode Island

We construct a preliminary offshore model of the crust and uppermost mantle at the Cascadia subduction zone using a full-wave ambient noise tomographic method. In total, we use more than 150 seismic stations from 2011-2012, including 57 ocean bottom seismometers deployed by the Cascadia Initiative community experiment and Neptune Canada, and about 100 broadband stations on land. The vertical components of the continuous seismic records are normalized with a frequency-time waveform normalization method, and then cross-correlated between each station pair to extract empirical Green's functions at periods of 7-50 s. We simulate wave propagation within a 3D Earth structure using a finite-difference method to generate a station Strain Greens Tensor database and synthetic waveforms. Rayleigh wave phase delays are obtained by cross-correlating the observed and synthetic waveforms. The sensitivity kernels of Rayleigh waves on the perturbations of V_p and V_s are calculated based on the Strain Greens Tensor database. We then invert for the velocity perturbation from the reference model and progressively improve the model resolution. We image a low-velocity anomaly off the center of the axial volcano within 28-40 km depth. There exist three segmented low-velocity anomalies along the forearc, which are spatially correlated with the pattern of offshore basins. The distribution of pseudofaults at the Juan de Fuca plate defines the seismic velocity heterogeneities.