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Structural Imaging in California Using Ambient Field Correlations

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Correlations of the ambient seismic field have been used successfully for tomographic imaging of the Earth on a wide range of scales. This is based on the theoretical and experimental observations that correlation functions computed between the signals recorded by two stations contain an approximation of the impulse response (Green's function) between these stations.
Numerous seismic sensors have been installed during the last decades in California and have recorded continuously ambient seismic field. These signals give the opportunity to image the California upper crust structure using ambient noise correlations. For the time period between 2001 and 2016, we are able to compute the correlation tensor between hundred pairs of stations. We measure the group and phase velocity for Rayleigh and Love waves, on the ZZ and TT components, respectively for the period range 5 s to 20 s. The velocities at each period are regionalized using a regularized straight-ray scheme and the local dispersion curves for Love and Rayleigh waves are jointly inverted to obtain shear-wave velocity vs. depth profiles. The final 3D velocity model clearly highlights the Central Valley sedimentary basin as well as higher velocity in Coastal Ranges and the Sierra Nevada batholith.
The waves that comprise the ambient field are subject to scattering due to the heterogeneous earth. It is possible to use the effects of scattering that do not correspond to the propagation between the two stations considered, to locate potential external sources of signal. We thus identify supplementary arrivals using array analysis to localize the source of scattering effects linked to strong structural variations. We are particularly interested in imaging scatters that result in coupling between the P-SV and SH systems because they are a consequence of lateral heterogeneities in Earth structure. For that reason, we are interested in components of the correlation tensor, different from the Vertical-Vertical component, and we expect the Radial/Vertical to Transverse components to be particularly helpful.