Seismic imaging with focusing surface waves obtained from USArray noise correlation functions

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Dense seismic arrays are equivalent to medical ultrasound transducers in the sense that both “devices” allow the reconstruction of refocusing wave fields at near-field distances. In this work we explore the imaging potential of refocusing surface waves constructed from USArray noise correlation functions using sensors located between the US west coast and -90 degrees West. So-called focal spots—a term adopted from elastography—are constructed from the noise correlation amplitude field at zero lag time around the origin, i.e., each sensor in the array. Similar to the related SPAC method, properties of the Bessel-function-shaped focal spot are controlled by the local medium properties, which underpins the local imaging approach. Unlike USArray SPAC applications in the 5 – 40 s period range, however, we proceed in the spirit of elastographic local measurements and demonstrate the possibility to estimate properties of Rayleigh wave propagation between 80 – 300 s period using the vertical-vertical and vertical-radial focal spot components of the Green's tensor. Clearly, the up to five-fold extension of the period range compared to noise- based USArray surface wave tomography studies are an intriguing asset of the approach that suggests a significantly increased depth resolution. In addition to demonstrating the general applicability of the focal spot method using dense array data, we address the biasing effects of less-than-ideal ambient wave field properties on our measurements. Impinging body wave energy and non-isotropic surface wave energy flux contribute to focal spot shapes and properties that are not compatible with the theoretical assumptions and used model functions and parametrizations. We show the space and period dependent distributions of these biasing components based on the focal spot representation in the wave number domain. Numerical and theoretical work discussed in an accompanying abstract is used to assess the impact on the dispersion measurements, and to test the effectiveness of filtering strategies for making improved estimates.