A new method to determine local amplification of Rayleigh wave

Yiran Huang and Colleen A. Dalton
Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI, United States

Rayleigh wave amplification and phase velocity have complementary sensitivity to depth-dependent seismic velocity and density, and jointly inverting the two data sets should lead to improved seismic models. We are developing an approach to determine the local amplification of Rayleigh waves on regional seismic networks. We measured the amplitudes of 20-100 s Rayleigh waves from 677 teleseismic earthquakes at the SVEKALAPKO, LAPNET, and ScanArray networks in Fennoscandia using ASWMS (Automated Surface Wave Measuring System; Jin and Gaherty, 2015). We form the ratio of amplitudes at nearby stations (Eddy and Ekström, 2014) to isolate the receiver effect from the source, focusing, and attenuation effects. In order to separate the effects of local elastic structure from erroneous instrument response in the amplification values, we apply a three-step process to the amplitude measurements. First, we use two high-quality permanent stations within the study area (KONO-IU and KEV-II) as references to identify erroneous instrument responses, some of which persist for the entire duration of the study and others that are time dependent. Second, by comparing amplitudes from every pair of nearby stations, time-dependent erroneous instrument responses that were missed in the first step are identified and removed. Third, we form a criterion from the correlation between predicted earthquake source excitation and observed amplitude and apply it to every station to remove outliers further. An additional challenge for our study is that the three regional seismic networks did not overlap in time, and yet the amplitude-ratio approach constrains only relative amplification between stations. We therefore constrain the amplification of one or more geographically adjacent station pairs from different networks to have the same value in order to obtain a coherent set of relative local amplification for the entire study area. We show that the station pairs for this constraint must be chosen with care and can have an important effect on the large-scale amplification variations. The final observed local Rayleigh wave amplification factors in the period 50s correlate well with predictions from regional models in Fennoscandia, with decreasing amplification factors from east to west.