Interferometric seismic imaging of crustal structure

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Over the past few years, the correlation-type reciprocity theorem for one-way wave fields has been extended to derive relations between the transmission and reflection responses of an arbitrary 3-D inhomogeneous medium(Wapenaar et al(2004)). Based on this generalized relation, the interferometric seismic profile(ISP) in the presence of passive seismic sources can be simulated by cross-correlating the transmission responses recorded at dense receiver array. The ISP approach inherently realizes symmetric pseudo-shot-receiver sampling, and prevents irregularities of offset distribution in CMP ensembles. We have investigated the possible application of ISP approach to teleseismic and regional earthquake data, which ensures the basic assumption of the correlation-type reciprocity theorem that the seismic source is located beneath the all reflectors to be reconstructed. Synthetic seismograms simulated by the elastic pseudospectral method for a simple 2-D crustal model are given to investigate the application of ISP approach to multi-component teleseismic data. The numerical modeling results demonstrate the potential imaging capabilities of ISP for crustal structure with a high spatial resolution rather than the conventional receiver function image of prestack depth migration. The main drawback with ISP is that spurious reflectors are created by partial focusing of virtual multiples. We applied ISP imaging to the teleseismic and regional earthquake data acquired along the the reflection survey line across the Itoigawa-Shizuoka Tectonic Line(ISTL), and utilized prestack depth migration for receiver function and pseudo-reflection P-P records to investigate the lower-crustal structure beneath the northern Fossa Magna basin. The phase with positive polarity at the depth of 38-40km in both receiver-function and ISP profile can be interpreted as that of Moho. The seismic profiles of teleseismic data show that Moho topography has a lateral variation and discontinuity in the limited survey area across ISTL.