Seismic interferometry and ambient noise tomography in East Asia

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Seismic imaging methods based on recordings of earthquakes suffer from various limitations. Above all, their resolution tends to degrade in areas of low seismicity, far from plate boundaries or other tectonically active areas. Waveforms from remote earthquakes are poor at high frequencies, due to the attenuation and scattering of waves along paths between sources and stations. This results in a low-resolution tomography with traditional surface waves.

Nowadays most of the seismological networks produce continuous records of ground movement. Huge amounts of data are accumulated and most of them are full of so-called seismic background noise that corresponds to the seismic waves produced by natural processes or human activity. The passive imaging is based on the possibility of extracting consistent information on the seismic wavefield between two sensors from the recordings of ambient noise.

The existence of correlation between seemingly random signals recorded at distant stations was first shown with the multiply diffracted wave coda (Campillo and Paul, 2003). The correlation is considered to be the Green's function that is the response of the Earth between two points, from which we can measure the travel time. Shapiro and Campillo (2004) has successfully applied the same approach to recordings of ambient noise and has opened the way for many applications (e.g., Kang and Shin, 2006; Choi et al., 2009).

In many recent studies where the noise was used to obtain the seismic response between two points, coherent waves were extracted from the noise even though at first glance, these coherent signals are hidden deep in an incoherent noise. One of concerns among those applications is the imaging of structures at different scales. Here the noise reduces the gap between spatial resolution methods based on earthquakes and active sources. Firstly, correlation methods used in seismology allow waves between stations near higher frequency than what is possible with remote earthquakes. The crust and upper mantle are now commonly imaged, mainly with surface waves, at scales ranging from thousands of kilometers to tens of meters. In addition to prospecting, correlations

can extend the analysis to lower frequencies compared to conventional active methods. In this presentation, some studies on seismic tomography using ambient noise cross-correlation in East Asia are introduced in various scales.

References

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