Name: Kiwamu Nishida

Division of Theoretical Geoscience,
Earthquake Research Institute, University of Tokyo

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Title: Seismic interferometry in the global scale: seismic exploration using seismic hum

Abstract:
The development of global surface wave tomography using earthquakes has been crucial for exploring the Earth's deep structure. It had been understood that only large earthquakes generate long-period seismic waves on observable levels, that penetrate deep enough into Earth for such exploration. The discovery of Earth's background free oscillations, also known as seismic hum, from 2 to 20 milli Hertz (mHz), now provides an alternative approach.

Recent observations have revealed the excitation mechanisms of seismic hum. Array observations by broadband seismometers showed simultaneous excitation of fundamental toroidal modes and fundamental spheroidal modes. Their excitation amplitudes above 5 mHz can be explained by random shear-traction sources on the Earth's surface. With estimated source distributions, the most possible excitation mechanism is a linear coupling between ocean infragravity wave and the seismic surface waves through seafloor topography. Below 5 mHz, the pressure sources on the Earth's surface are comparable to the shear traction sources. The observed acoustic resonance between the atmosphere and the solid Earth at 3.7 and 4.4 mHz suggests that atmospheric disturbances are responsible for the surface pressure sources, although a nonlinear process of ocean waves is also a candidate. Excitation mechanisms of seismic hum should be considered as superimposition of the processes of the solid Earth, the atmosphere and the ocean as a coupled system.

We conducted global upper-mantle seismic tomography using seismic hum without referring to earthquakes. At periods of 100 to 400 seconds, the phase-velocity anomalies of Rayleigh waves are measured by modeling the observed cross-correlation functions between every pair of stations globally distributed seismic stations [Nishida et al., 2009]. The anomalies are then inverted to obtain the three-dimensional S-wave velocity structure in the upper mantle. Although we applied ray theory for the tomography in the study, a finite-frequency sensitivity kernel has been applied in these years. To discuss the theoretical background of the sensitivity kernel, a simple form of a

two-dimensional (2-D) Born sensitivity kernel is developed at a finite frequency for the cross-correlation function. We will discuss the finite-frequency effects.