A source model of simultaneous excitation of background Love and Rayleigh waves

Yoshio Fukao[1]; Kiwamu Nishida[2]

[1] IFREE/JAMSTEC; [2] ERI, Univ. Tokyo

Earth's background free oscillations have been so far interpreted as the Earth response to pressure disturbances in either the atmosphere or oceans acting randomly on the Earth's surface, which can little excite Love waves. Nishida et al, however, reported (in this session) evidence of background Love waves from 0.01 to 0.1 Hz. The ratio of kinetic energy of Love to Rayleigh waves is about 1. The wave energy is greatest along trench-arc systems, next from abyssal seafloors and least from continents. Here we present a source model that can explain these observations. In our model long-period Rayleigh and Love waves are generated by shear traction that acts on the sea bottom horizon upon coupling of infragravity waves with seafloor topography. We consider two types of seafloor topography, (1) low-amplitude undulation of abyssal plain with which propagation speed of infragravity wave changes insignificantly, and (2) steep inner slope that separates deep sea (abyssal plain) from shallow sea (continental shelf). In the first model infragravity wave with wavenumber k is coupled with seafloor undulation with the same wavenumber so that the bottom pressure can produce shear traction on the bottom horizon with effectively zero wavenumber. In the second model infragravity wave generated in shallow sea propagates oceanward across the inner slope where transmitted and reflected waves are generated. Phase velocity, wavenumber and bottom pressure in the shallow sea are significantly different from those in the deep sea and their changes occur rapidly across the inner slope. For given depths of the shallow and deep seas, infragravity wave can couple with the slope topography at a certain ratio of wave frequency to slope gradient. In this coupling state the bottom pressure acting on the slope produces shear traction containing effectively zero wavenumber component. In either case topographic coupling produces shear traction with the effectively zero wavenumber component which can efficiently generate both Rayleigh and Love waves. In our model the direct excitation source of background Raylegh and Love waves is in the ocean. However, infragravity waves in the ocean can poorly excite background infrasound free oscillations that are resonant with background Earth's free oscillations. Low frequency background infrasound has to be excited directly by atmospheric turbulence. The background free oscillation phenomena should be understood as those involving the atmosphere, ocean and solid Earth in a single system.