Spatial distribution of excitation source of Earth's background free oscillations

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The phenomenon of Earth's background free oscillations has now been confirmed firmly [Kobayashi and Nishida 1998; Nawa et al. 1998; Suda et al. 1998]. Their excitation amplitudes and statistical features indicate that the excitation source is persistent disturbance at or just above the whole Earth's surface. The observed amplitudes also show clear annual variations and acoustic resonance between the solid Earth and the atmosphere, suggesting that the most likely excitation source is atmospheric disturbance.

Recently some groups proposed that oceanic disturbance is more likely excitation source (Watada 2002; Rhie and Romonowicz 2004). Geographical coupling and nonlinear effects near coasts becomes important. Rhie and Romanowicz [2004] inferred spatial distribution of the sources using array analysis of broadband seismometers. Based on coincidence between the resultant spatial distribution and that of wave height data they concluded oceanic disturbance is most likely source. However there is still ambiguity of their spatial distribution. To constrain their excitation source we developed new inversion method of spatial distribution of excitation source in this study.

We formulated a cross-spectrum of Earth's background free oscillations based on Fukao et al. [2002], assuming that the atmospheric turbulence generates random pressure forces acting on the surface of the solid Earth. We also assumed that their spatial distribution of the sours can be represented sum of spherical harmonics up to degree 7. We first calculated stacked cross-spectra for every pair of 55 stations from 3 to 6 mHz. Then we fitted the synthetic spectra to these observed spectra every month.

Resultant spatial distribution of the sources shows structure of lower degree is dominant. Their amplitude maxima are on the Pacific Ocean from November to February, whereas they are on high latitude region of southern hemisphere from June to September. This result suggests that neither purely uniform atmospheric disturbance nor purely oceanic disturbance explains the observed amplitude pattern of Earth's background free oscillations.