Core-Mantle boundaries state estimation applying the strain analysis on frequency domain

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It is well known that seismic waves, especially surface waves, of a huge earthquake can go around on surface of the earth many times. Surface waves trace on a spherical earth surface many times and become a standing wave, deform the earth, such as to expand and contract or to twist, periodically. These periodical deformations of the earth are so called 'earth free oscillation.' Observing the amplitude and period of these oscillation mode of the earth, we can understand a condition of inner structure of the earth.

In this study, we applied strain analysis on the frequency domain (so called FSA; *c.f.* Okubo, 2007) to the dynamic strain records, which observed at the 2011 off the coast of Tohoku Earthquake. Originally, applying strain analysis, we can determine the principal strain magnitude and its direction from time series changes of the independent three horizontal components. on the other hands, FSA is able to estimate the principal strain azimuth for each frequency. Dynamic strain records we used (UWA1 belonging AIST) contain independent four horizontal components, thus the four principal strain directions can be determined independently, and can be evaluated the mean value, and determination accuracy from the deviations. We determined the natural frequencies of earth free oscillations, and Q values representing the attenuation of the amplitude corresponding to the state of Core-Mantle boundaries (CMB).

We first applied a Fourier analysis to each of the four horizontal components with a data length of 37 hours (133200 s) from 00:00 on March 11, 2011, and obtained amplitude-phase spectra. Next, we estimate averaged the principal strain azimuths and deviations from four spectra applying with Okubo (2009) procedure. Since the earth free oscillation phenomenon is a periodic global vibration, deviations of the determination should be small. Therefore, we set a threshold 5 degrees for deviation, and surveyed nearby frequencies predicted by PREM (Dziewonski and Anderson, 1980). As a result, three frequencies of 0.315 mHz, 0.382 mHz, and 0.818 mHz were obtained, corresponding to ${}_0S_2$, ${}_0T_2$ and ${}_0S_0$, respectively. These frequencies are almost same as the frequencies predicted by PREM. Furthermore, performing the same procedure with the start time shifted a hour, we determined the temporal changes in amplitude for the three frequencies. We finally estimated the Q^{-1} value corresponding to each frequency mode, fitting with the damped oscillation equation.

As a result, we obtained 378.5, 31.3, and 235.7, corresponding to ${}_0S_2$, ${}_0T_2$ and ${}_0S_0$, respectively. In PREM, these values were mentioned 509.6, 250.4, and 5327.6, our results seems to smaller than PREM.

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