Stability of H/V spectra of ambient noise from ocean bottom seismometers (OBS) near the Japan Trench

*Atikul Haque Farazi[1], Yoshihiro Ito, Emmanuel Soliman M Garcia

1. Disaster Prevention Research Institute, Kyoto University

Ocean bottom seismometers (OBS) are being widely used to monitor seismicity of slow earthquakes as well as that of ordinary earthquakes. Seismic velocity structures, especially of S-waves, are essential to estimate hypocenters of them with accuracy. The horizontal to vertical spectral ratio (H/V) method, originally proposed by Nogoshi and Igarashi (1971) and familiarized by Nakamura (1989), is a potential technique to get S-wave velocity structure by inversion of the H/V curve. Here, we aim to use the ambient noise H/V method utilizing OBS data. From this perspective, currently we focus upon spatial and temporal stability of H/V spectra of ambient noise from OBS data as the first step towards future application of this method to estimate S-wave velocity structure deploying the existing OBS stations. We use the Nakamura’s method (1989) for obtaining H/V spectra using a 3-component (H1, H2, and V) OBS array in the Japan Trench area to characterize deep structure above the plate interface near the trench. 21 OBS, 3 broadband and 18 short-period, stations have been used in this study. To retrieve the spectra, processing to the waveform data is applied, the first step of which include removal of instrumental response, and downsampling of the trace to 20Hz, removal of mean and trend from the record, tapering, and filtering. Then, Fourier amplitude spectra of each 3 components are obtained applying fast Fourier transformation (FFT). After that, we applied smoothing to the amplitude spectra following Konno and Ohmachi (1998) method. Next, the 2 horizontal amplitude spectra (H1 and H2) are merged together by taking their quadratic mean (H). Finally, H/V spectral ratio is achieved for the selected time window by dividing the mean of the horizontal components (H) by the vertical component (V). Prior to preprocessing, each 24-hours record was split into 1-hour window, and we selected time windows which are quiet or devoid of any earthquake arrivals so that use of the ambient noise part of the record is ensured. The quiet hours or time windows are selected manually making dayplots (or hourly plots) for each components of a station, from their spectrogram for checking the frequency content, and also from power spectral density (PSD).

The 1-hour H/V spectra of every station are primarily examined to see if their shape indicates similarity suggesting high stability. The 1-hour spectra are then stacked together and averaged in a single window to get each 1-day spectra. These 1-day spectra are also compared for understanding the temporal stability of the H/V spectra from individual OBS station. These 1-day spectra are also stacked and averaged to get the final H/V curve of a single station. The final spectra of a single station is then compared in between stations to discern the spatial stability. Stability of H/V spectra of ambient noise from OBS data is promising for conducting our future work for deeper observation using the ambient noise H/V method.

Keywords: Ambient noise, The H/V method, Ocean bottom seismometer (OBS), Spatial and temporal stability of H/V spectra

