S221-P004 **Room: Poster Session Hall** **Time: May 18**

Estimation on the azimuth of the MeSO-net borehole seismometers based on the long-period seismic motion

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Remarkable high-density seismograph network, called MeSO-net, is under constructing within the Tokyo metropolitan area, central part of Japan. As for March 2008, 46 stations have already established. 400 stations will be installed finally in the metropolitan area within next a few years; this seismic network will bring us important information to understand seismo-tectonics in the area. At the station of the MeSO-net, three-component accelerograph is installed at the bottom of the borehole with 20 m depth. In order to analyze the horizontal component waveform observed at borehole type seismic station, we have to know the orientation of the seismometer beforehand. Sasaki et al. [2008; ASC] already analyzed the horizontal orbit of the P wave from the 2008 Northern Iwate Prefecture earthquake (Mj6.8) and estimated the azimuth of the MeSO-net seismometers. However, underground structure beneath the Kanto region is very complicated and the orbit of the P wave may not correspond to the backazimuth because of wave diffraction. In this study, we use the teleseismic waveforms with long-wavelength component and estimate the MeSO-net sensor azimuth based on the method by Shiomi et al. [2003; Zishin]. We used four earthquakes with magnitude 7.3 or larger. First, we convert accelerograms observed at the MeSO-net stations to displacement waveforms and apply the band-pass filter with band-width between 50 to 100 seconds. On the other hand, we choose a NIED F-net and 11 Hi-net stations located within 22 km from MeSO-net stations, and get 50 to 100 s band-passed displacement waveforms as reference waveforms to estimate the MeSO-net sensor azimuth. In order to compose NS and EW component waveforms at the Hi-net stations, we use the information about sensor azimuth on the Hi-net website. We rotate the MeSO-net waveform every one degree and calculate the cross-correlation coefficients against the reference waveform. For each MeSO-net station, cross-correlations coefficients for all earthquakes and all reference station are averaged with some weights related to the station distance and correlation coefficients. We conclude that the rotation angle that shows the maximum cross-correlation coefficient is the MeSO-net sensor azimuth. According to our analyses, it becomes clear that the sensors at two stations, E. SKMM and E.YTBM, are rotated 180 degrees. The N-component of the sensor at E.MKJM directs to southwest. At the other stations, the N-component of the sensors direct within +/- 15 degrees from the magnetic north. Our results are well coincident with the results estimated by Sasaki et al. [2008]. However, at the stations in the northeastern part of the study region, we can confirm that there are systematical azimuthal difference (6 ˜8 degrees) between two results. Shiomi et al. [2003] indicated that the similar features are observed at the Kushiro Marsh and around Hidaka Mountains in Hokkaido, and they implied the possibility that the P wave orbits by local earthquakes were diffracted by underground structure. Since the subducting Pacific slab is lying beneath the Kanto region and thick sedimental layers exist in the Kanto plain, we have the possibility that the P wave were diffracted by the complicated underground structure. We should check the waveform cross-correlations with other station pairs and the P-wave orbits by other local earthquakes.