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Anomalous seismic wave intensity distribution in the Tokyo Metropolitan area.

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The intensities of seismic waves observed at the dense seismic array of the Tokyo Metropolitan Seismic Observation network (MeSO-net) inside the Kanto basin, display unusual distribution patterns. In several occasions, the highest intensities are not observed in the area above an earthquakes hypocenter but appear sifted more than 20 km away. In order to understand the source of this unusual intensity distribution pattern, it is crucial to understand how the waves attenuate before they reach the surface. The attenuation of seismic waves along their path is represented by the t$*$ attenuation operator that can be obtained by fitting the observed seismic wave spectrum to a theoretical spectrum using an ω^2 model. In order to create a high quality dataset, only 1449 earthquakes that are recorded with intensity greater than 0 in the Japan Meteorological Agency (JMA) intensity scale are selected from the JMA unified earthquake list from April 1st 2008 to October 2nd 2013. A grid search method is applied to determine the t$*$ values by matching the observed and theoretical spectra. The t$*$ data where then inverted to estimate a 3D Q structure with grid points set at a 10 km spacing. We implemented the 3D velocity model estimated by Nakagawa et al., 2012 and in addition we set the initial Q values at 100 for the 0 km grids and to 400 for the grids below them. The obtained model suggests average Q values of 50$\sim$100 inside the Kanto basin. Furthermore, a low Q zone is observed in the area where the Philippine Sea plate meets the upper part of the Pacific sea plate. This area is located at approximately 40 km depth, beneath the north-east Tokyo and west Chiba prefectures and is represented by Q values $<$300. Earthquakes occurring on the Pacific plate pass through this low Q area inside the Philippine sea plate and are attenuated significantly. The estimated attenuation distribution at the MeSO-net station for these earthquakes implementing our 3D Q model greatly coincides with the observed seismic wave intensity distribution. Stations where our model predicts high attenuation display low intensity values whereas stations where our model predicts low attenuation display high intensities. The implementation of our findings could help towards a better understanding of the damage area of future earthquakes and mitigate the disaster of the affected areas.

Keywords: Attenuation, Tomography, MeSO-net