Imaging of subsurface structure and monitoring social activity using seismic ambient noise

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Seismic ambient noise has been used to various fields and purposes because of theoretical understanding and the development of seismic observation networks. One of the most important features of the ambient seismic noise is the constant presence of it. This makes it possible to conduct the passive geophysical exploration by using ambient seismic noise. The surface waves which propagate between station pairs can be extracted by using the seismic interferometry. We can image and monitor underground structures by using extracted surface waves. In recent years, geophysical explorations using anthropogenic seismic noise above 1 Hz which is generated from specific human activities have been conducted. In Japan, there are many seismic observation networks such as Hi-net and MeSO-net, and the development and improvement of the analysis method using ambient noise will lead to the efficient use of these networks. In this presentation, we will discuss about the imaging underground structures using ambient noise and use of anthropogenic seismic noise from human activities.

(1) Imaging underground structures using ambient noise
S-wave velocity structure is required in a wide range of fields such as earthquake hazard prediction, geological interpretation, and resource exploration, and more accurate velocity models are required. The dispersion curves of surface waves propagating between station pairs can be estimated from the cross-correlation of seismic ambient noise, and the S-wave velocity structure model with high spatial resolution can be estimated by tomography and array analysis. In addition, since higher-order modes of surface waves reflect deeper structures than fundamental modes, inclusion of higher-order modes in inversion can improve vertical resolution. In this presentation, the estimation of Rayleigh and Love waves including higher-order modes and the estimation of S-wave velocity structures with high accuracy by joint inversion will be discussed.

(2) Monitoring human activities using anthropogenic seismic noise
In recent years, the decrease of vibration caused by human activities due to the lockdown associated with the outbreak of coronaviruses has been reported worldwide, and there is a high interest in anthropogenic seismic noise. The study of these seismic noise is important for the improvement of the accuracy of observation of natural earthquake, and the application to geophysical exploration using anthropogenic seismic noise. In this presentation, we will discuss the changes in economic and leisure activities based on the temporal changes of anthropogenic seismic noise observed by the MeSO-net during the COVID-19 pandemic. The possibility of detecting specific human activities will also be discussed.

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