Visualization of seismic wave propagation on the Japanese Islands produced by high-sensitivity seismograph network, NIED Hi-net

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After the Hanshin-Awaji Earthquake in 1995, the densely distributed high-sensitivity seismograph network, Hi-net has been deployed by the National Research Institute for Earth Science and Disaster Prevention.　Now, the Japanese Islands are covered by a very dense seismic network composed of Hi-net and pre-existing seismic stations operated by universities and JMA, etc.　As the result of the dense seismic network, the detection capability for microearthquakes and the resolution in the hypocentral determination were extremely improved. The discovery of the deep low-frequency tremor in southwest Japan (Obara, 2002) is one of the results of improvement in detection capability for micro seism. The Hi-net has been established as the fundamental data source for the monitoring of seismic activity in Japan.

The Hi-net is very useful in the study of the Earth interior structure. There are many unresolved seismic phases generated by conversion, reflection, and/or scattering process at the discontinuity in the underground structure. The densely distributed seismic network enables us to identify some coherent patterns of these phases on the paste up seismograms plotted with increasing distance. The spatial dependence in amplitude and travel time of the phases detected by the dense seismic array may be helpful for the determination of the wave-type, location and properties of the discontinuity.

On the other hand, the dense seismic network provides the opportunity for making animation of wave propagation. For example, sequence snapshots of the seismic amplitude distribution looks like an animation, which is very easy to understand the wave propagation for not only seismologists but also ordinary people. The deep earthquake which occurs in the descending Pacific plate beneath southern off Tokai usually brings anomalous seismic intensity distribution in the eastern part of Honshu.　The phenomenon is caused by the strong contrast in attenuation and scattering properties in and around the subducting Pacific plate.　The animation of the wave propagation from the deep earthquake clearly shows the difference of the seismic intensity in the western and eastern Japan.　We can also see the amplitude increasing prior to the arrival of the S wave in the northern part of Kanto area.　This is caused by the SP scattering waves at the plate boundary.　The animation is very useful for the identification and spatial extension of the seismic phenomena.

The animation of the wave propagation is very useful for not only local earthquakes, but also for teleseismic waves.　As for the local earthquake, the animation is usually created by snapshots of seismic energy distribution. However, in many cases, the teleseismic wave is predominant in longer wave-length components and the coherency of the waveform pattern in neighbor stations becomes good because of not affection by small-scale inhomogeneity.　Therefore the animation is made by snapshots of seismic amplitude distribution.　For the Sumatra earthquake on December 26, 2004, many seismic waves have been detected including surface waves traveling along the great circle many times.　The animation of the wave propagation from the Sumatra earthquake easily shows the difference in the wave speed and wavelength of P, S and surfaces waves. The difference in the ground motion of the Rayleigh and Love waves are easily recognized by this animation. On June 24, 2001, M8.4 earthquake occurred at Peru. The animation of the surface wave displays the propagation direction from northeast to southwest, which remind us that the Earth is sphere.　The animation of seismic wave propagation might be a great tool for science education for young ages.