Visualization of seismic wave propagation for observed data and synthetics: --- Case of the 2003 Tokachi-oki earthquake ---

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http://www.j-map.bosai.go.jp/GMS/

Seismic wave propagation is one of the most basic phenomenons in the seismology. To grasp the wave propagation, it is necessary to handle the spatial-temporal data. When data becomes larger, visualization techniques save us a lot of troubles and make it easy to understand the entire phenomenon.

After the 1995 Hyogoken-Nanbu earthquake, NIED (National Research Institute for Earth Science and Disaster Prevention) installed the K-NET and KiK-net that uniformly covers all over Japan with more than 1700 strong-motion accelerometers. The 2003 Tokachi-oki earthquake was a interplate earthquake of Kuril Trench, which is the first large a interplate earthquake around Japanese Islands after these seismograph network has installed. The ground motions of this earthquake were recorded at 655 station in northen Japan and the long-period ground motion with long duration was observed. The observed acceleration records were integrated into velocity and bandpass filtered between 5 – 50 sec. By specially interpolating these data, we obtained the snapshot of ground motion distribution. These interpolations are reasonable in this period range taking the station interval and wavelength into consideration. From the image processing results, it was made clear that the large amplitude and the long durations of ground motion in Yufutsu plains, which contains Tomakomai City, Ishikari plains, Teshio plains, and Konsen plain (Fig. 1).

To examine this phenomenon, we constructed underground structure and rupture models and performed a simulation of the wave propagation of this earthquake with 3D finite-difference method ([1] Aoi et al., 2004). For this simulation, we used GMS (Ground Motion Simulator; [2] Aoi et al., 2001), which employs HDF5 ([3] NCSA, 2000). HDF5 is a general-purpose file I/O library and provide the function for random access and data compression. This efficient I/O system makes it possible to visualize large-scale volume data. Fig. 2 shows the snapshot of wave propagation in 3-D volume and also on the profile including Tomakomai. It is clearly shown that the incident waves are amplified by the soft sediment and successfully reproduced the long-duration wave in the Yufutsu plain. Waves are trapped in the soft sediment and continue for several hundred seconds by propagating back and forth in the plain.

[1] Aoi, Honda, Morikawa, Hayakawa and Fujiwara (2004), 3-D Finite Diffrence Simulation for the 2003 Tokachi-oki Earthquake, Abst. JEPS joint meeting

[2] Aoi, Fujiwara, Hayakawa and Narita (2001), Development of the strong ground motion simulator(No.2) FDM subsystem, Abst. JEPS joint meeting

[3] The National Center for Supercomputing Applications (2000), http://hdf.ncsa.uiuc.edu/HDF5/

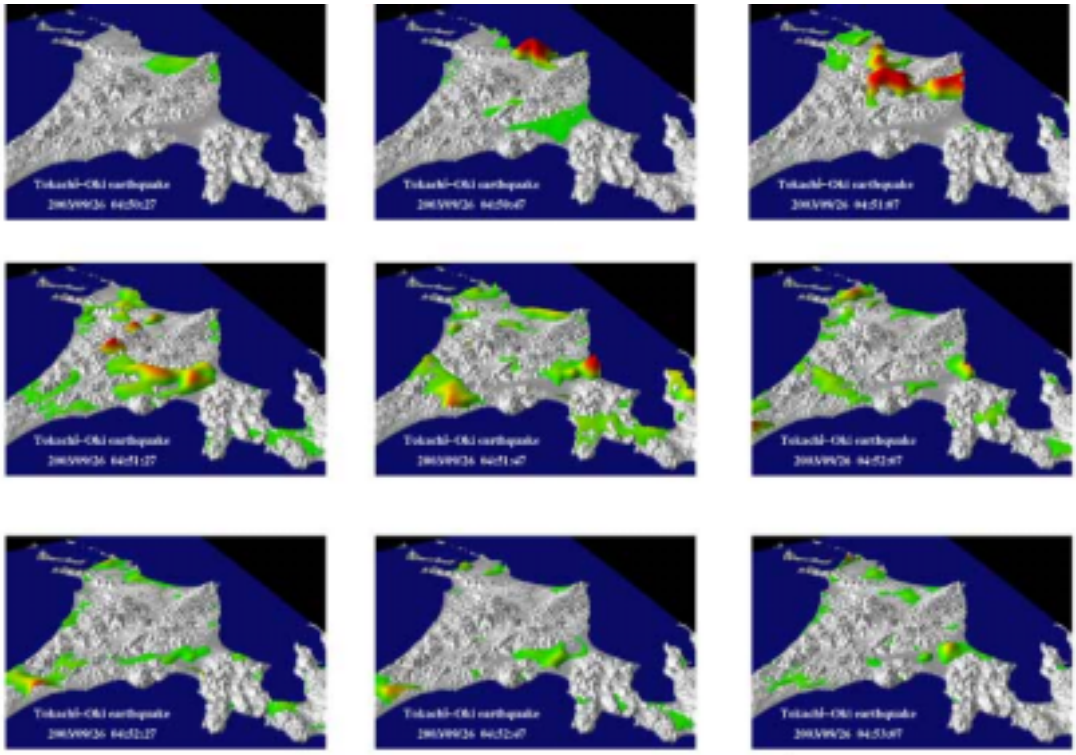

Fig. 1: Snapshots of wave propagation based on the observed data recoeded by K-NET and KiK-net during the 2003 Tokachi-oki earthquake.

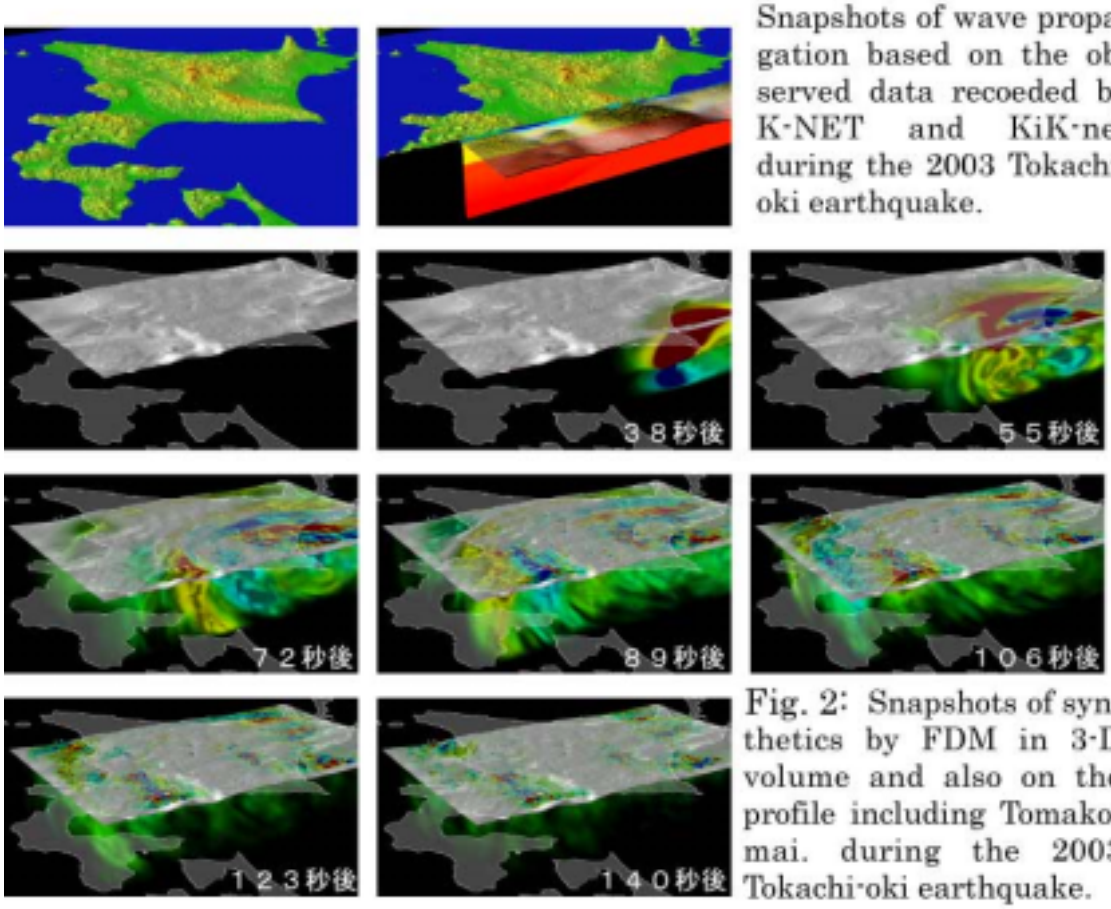

Fig. 2: Snapshots of synthetics by FDM in 3-D volume and also on the profile including Tomakomai. during the 2003 Tokachi-oki earthquake.