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Hyper resonance in the southern part of the Boso Peninsula for a period of 15 s to 20 s

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1. The Mw8.4 super sub-event associated with the 2011 Mw9 Tohoku earthquake

Analyzing GPS high sampling displacement records of the 2011 Tohoku earthquake, Kawasaki et al. (2014) showed the followings:

The most dominant phase was the main pulse of a width of around 100 s and amplitude of a few meters in the Tohoku distinct (epicentral distances from 100 km to 350 km). An overall feature of the main pulse was explained by a simple rectangular fault model of low angle thrusting, which started about 35 s after the JMA origin time and released an interplate moment corresponding to Mw9.

The second was the ”sub-pulse” (SH wave). Fig.1 shows record sections of transverse component of the GPS high sampling records for every 5 degree from N135W to N155W in the Kanto District (epicentral distance of 420-460 km). The distinguished pulse between two vertical broken lines at 65 s and 95 s was the sub-pulse of a width of around 30 s and amplitude of up to 1 meter. An overall feature of the sub-pulse was fitted by an Mw8.4 super sub-event fault model of strike slip faulting on nearly vertical plane striking in N140E direction.

2. Hyper resonance of a period of 15 s to 20s

The most remarkable phase following the sub-pulse is the hyper resonance (HR-1), which is a phase of a few cycles with a period of 15-20 s and peak-to-peak amplitude of up to 1 m in azimuths of N140W-N145W and N145W-N150W. The hyper resonance could be attributed to the Tertiary accretionary layer.

About 30 min later, the largest aftershock (MJ7.6) occurred around 50 km east-off the Kanto District. A width and amplitude of a main pulse in the transverse component records are 15 s to 20 s and amplitude of up to 30 cm, respectively, in the Boso Peninsula (150 km to 200 km).

Each pulses of the hyper resonance due to Mw9 event are much greater than the main pulse of the MJ7.6 aftershock.

3. A resonance of a period of 10 s to 15 s

The second (R-2) is a resonance of a period of 10-15 s, amplitude of 10 cm to 20 cm and duration time of a few minutes in the northern part of the Chiba Pref., where the thickness of the Tertiary sedimentary layer is up to 3 km.

4. A resonance of a period of 5 s to 10 s

The third (R-3) is a resonance in the central part of the Kanto basin of a period of 6-8 s, which is so-called the long-period strong ground motion.

5. Concluding remarks

We have recognized the distinguished resonances mostly in the Kanto District, triggered by the giant SH waves due to the Mw8.4 super sub-event. Similar resonances due to the largest aftershock are recognized with one-order smaller amplitude. One of common features is that the resonances are remarkable in the transverse component rather than radial and vertical component records.

Reference

Kawasaki, I., H. Ishii, Y. Asai, and T. Nishimura, 2014, An Mw8.4 super sub-event associated with the 2011 Mw9.1 Tohoku earthquake, Zisin2, 87-98, in Japanese.

Fig.1 Record sections of transverse component displacement of GPS high sampling data in the Kanto District observed for the 2011 Mw9 Tohoku earthquake. Horizontal scale is a travel time in s reduced by 3.9 km/s. Vertical scales at left and right sides are amplitude and epicentral distance, respectively. HR-1 denotes the hyper resonance of a period of 15-20 s and peak-to-peak amplitude of up to 1 m. R-2 and R-3 denote resonances of periods of 10-15 s and 6-8 s, respectively.

Keywords: hyper resonance, GPS high sampling record, 2011 Tohoku earthquake, Boso Peninsula, Tertiary sedimentary layer

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