Efforts to Estimate the Scale of Damage in the Information Vacuum Period After an Earthquake

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1. Introduction

Many earthquakes with a seismic intensity of lower 6 or higher occurred in 2016. Two earthquakes with an intensity of 7 hit Kumamoto on April 14 and 16. Destructive earthquakes hit Uchiura Bay (intensity of lower 6), the central area of Tottori Prefecture (intensity of lower 6) and the north area of Ibaraki Prefecture (intensity of lower 6) in the same year.

When a major earthquake occurs, the NILIM dispatches the TEC-Force to the affected areas to determine whether the affected facilities can be in service and provide support for earlier restoration. To do this, it is necessary to collect information about the damage on infrastructure facilities promptly. However, such information cannot be fully obtained immediately after an earthquake. The Earthquake Disaster Management Division estimates the approximate scale of the damage by preparing spectrum analysis data and supports the quick response by NILIM after the occurrence of an earthquake.

2. Line of Damage

In Figure 1, multiple acceleration response spectra (attenuation constant: 0.05) are overwritten, which were prepared by using the Strong Motion Seismograph Network (K-NET and KiK-net) of the National Research Institute for Earth Science and Disaster Resilience and the strong-motion earthquake record of the Meteorological Agency obtained from the earthquakes in the northwest area of Kagoshima Prefecture in 1997, off the coast of Miyagi Prefecture in 2003, and in Suruga Bay in 2009, which caused limited damage (with less-than-ten completely destroyed buildings). A black arrow and a red zone in Figure 1 indicate the range of the characteristic period of around one to two seconds, which is thought to have an influence on the structure and cause damage. Out of these spectra, we eliminated the record of K-NET Akune, which was exceptionally huge, and defined the upper limit of the remaining spectra as the line of damage.

When strong motion exceeding this line was observed, there was a possibility of damage to such structures as bridges and low- and medium-rise buildings and the approximate scale of the damage caused by the earthquake was thought to be estimated.

3. Spectrum Analysis Data of 2016 Kumamoto Earthquake

The records of earthquakes in 2016 with a seismic intensity of lower 6 or higher, including the Kumamoto Earthquake and acceleration response spectra (attenuation constant: 0.05) of typical strong-motion records of major earthquakes that caused damage are shown in Figure 2. As the spectrum of both the foreshock and main shock of the Kumamoto Earthquake showed values equivalent to major earthquakes in the past and greatly exceeded the line of damage, it is expected that structures were damaged there.

When we look at earthquakes with limited damage, the spectra go far below the line. This eloquently shows that the line is consistent with the scale of damage to structures.

4. Future Plan

We are going to analyze the intensity of the ground motion and damage from earthquakes in the past and verify the effectiveness of the line of damage occurrence. We are also distributing the data of the spectrum analysis from April of this year in order to support the initial response of the Regional Development Bureaus at the time of an earthquake.

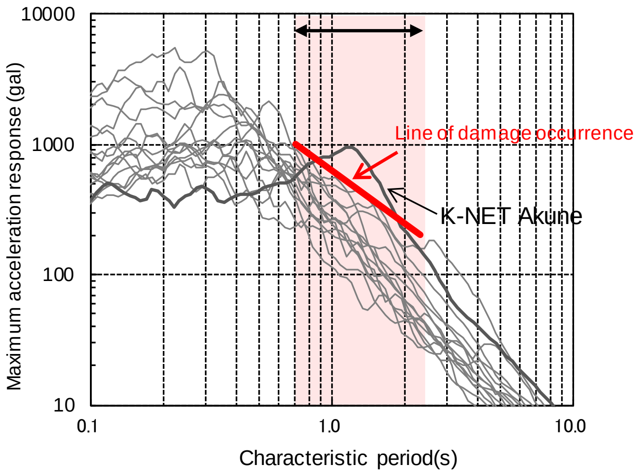

Figure 1: Examination of Acceleration Response Spectrum and Line of Damage

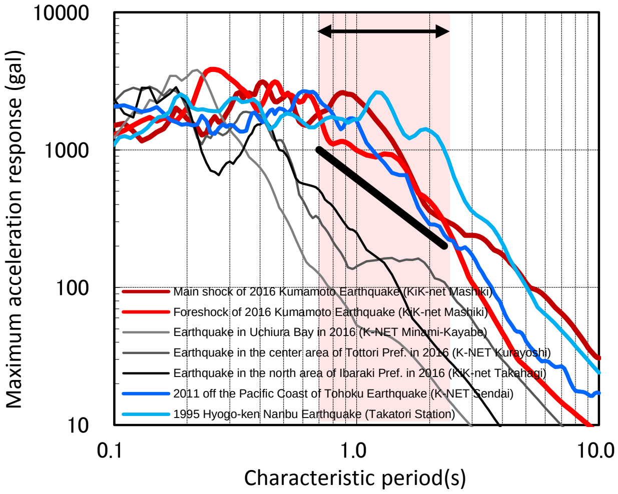

Figure 2: Comparison between Earthquakes in 2016 and in the Past