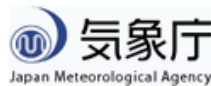


Information on long-period ground motion of the Japan Meteorological Agency (JMA)

Masaki Nakamura
Japan Meteorological Agency

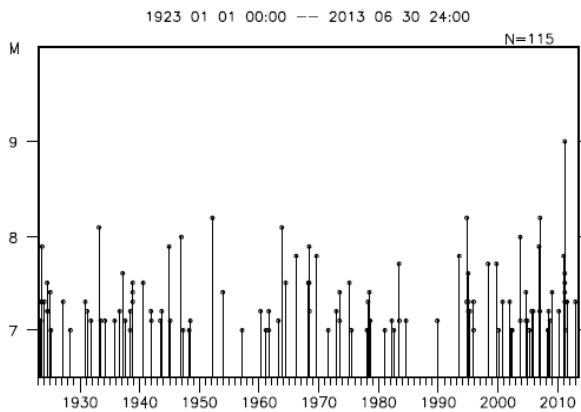


Outline

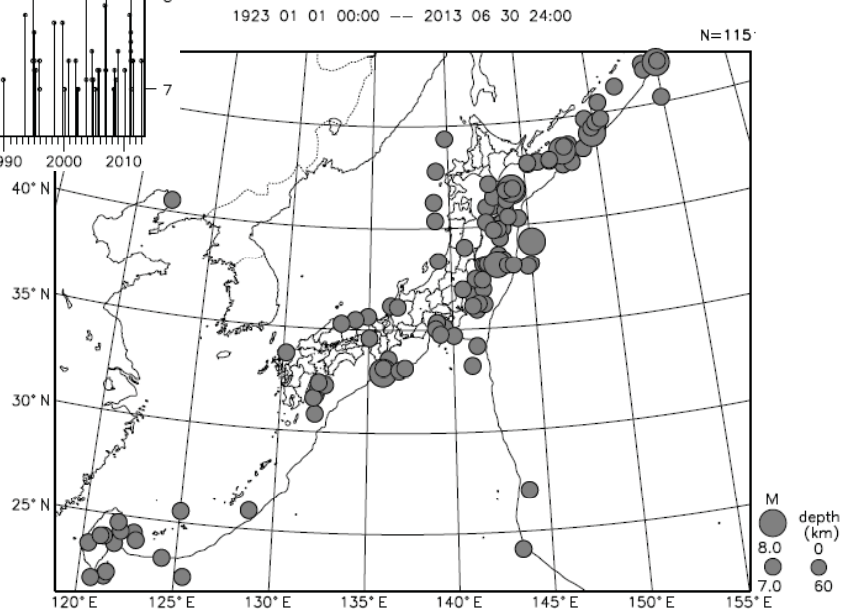
- Need for long-period ground motion.
- Information on long-period ground motion.
- How to use the information.
- Future plans.



Need for long-period ground motion



- ◆ Many large shallow quakes occurred in Japan. From 1923 to June, 2013, 115 events ($M \geq 7.0$). 8 events ($M \geq 8.0$).
- ◆ Large shallow earthquakes often generate long-period ground motions.

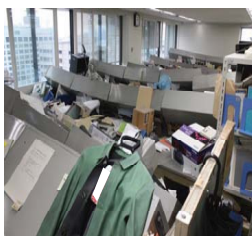


Need for long-period ground motion

Example: The 2011 Great East Japan Earthquake (M 9.0)

In Tokyo metropolis,

- Several non-structural elements and equipments in high-rise buildings suffered damage, while lower buildings didn't have much damage.



Fall of Unsettled Objects



Fall of Cover at Expansion Joint



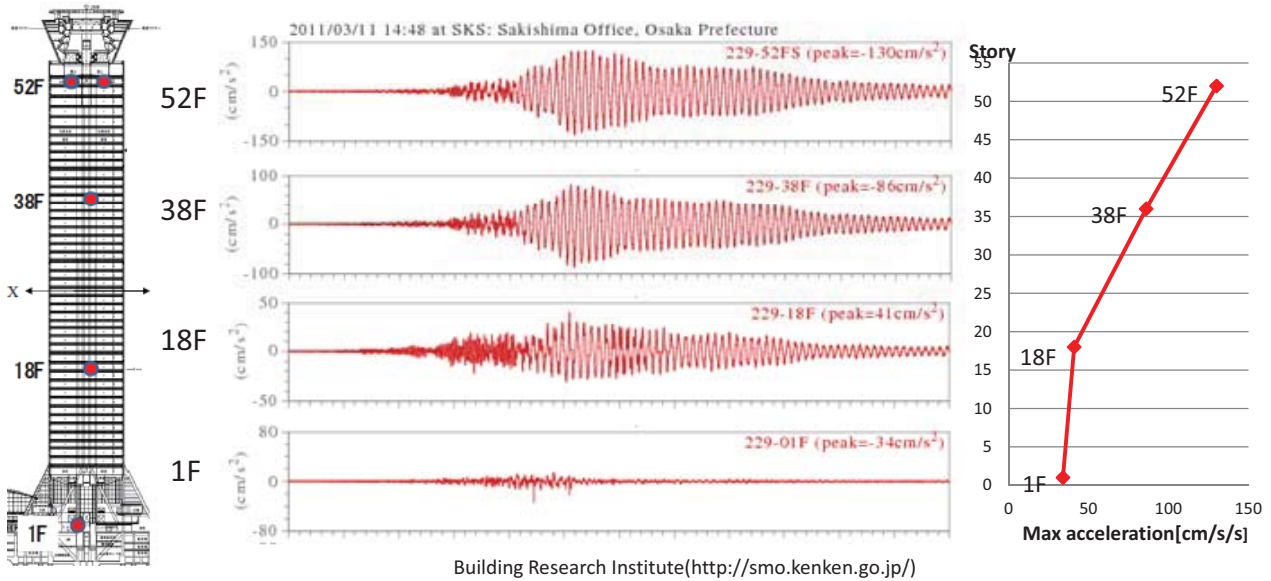
Tangled elevator cable

In Osaka, which is 700 km away from epicenter,

- High-rise buildings were shaken severely on higher floors by the long-period ground motions.
- Short-period ground motion was not very severe.

Need for long-period ground motion

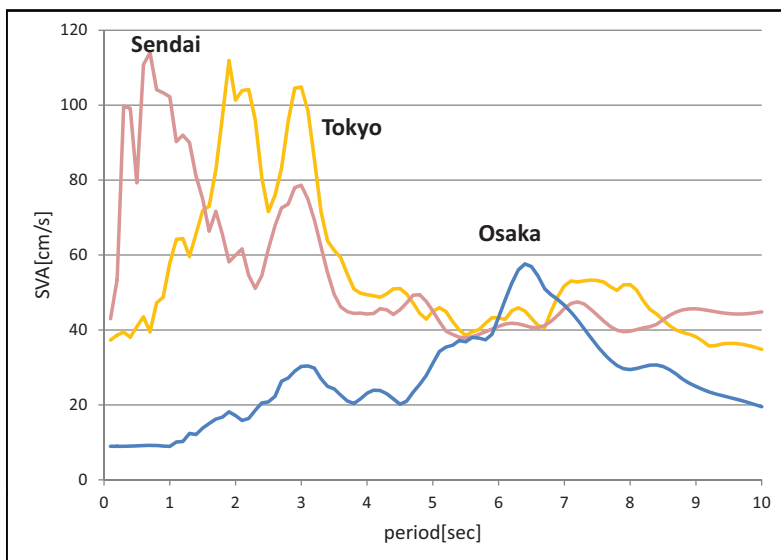
Observed wave forms in a building in Osaka (700 km away from the epicenter)



- As shakings in higher floors are different from that in lower floors, conventional seismic intensity scale applied to the surface of the earth cannot express long-period ground motion in a high-rise building properly.

Phenomena by the Great East Japan Earthquake in 2011 (M 9.0)

Need for long-period ground motion

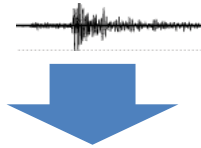


- Osaka is 700km away from epicenter.
- But, absolute velocity response spectrum(SVA) was larger in Osaka than at nearer stations at a period of around 6 sec.

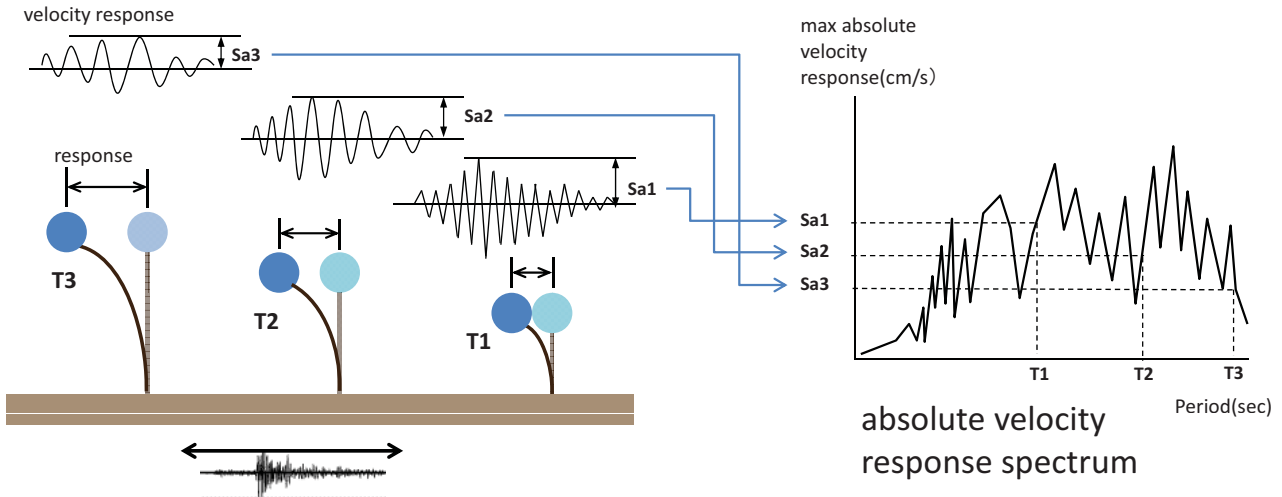
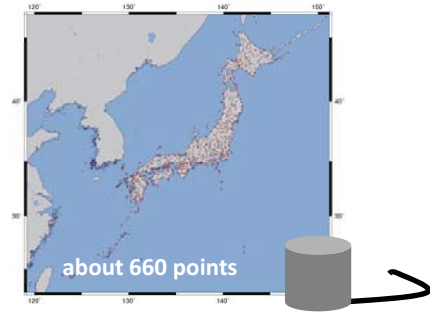
Phenomena by the Great East Japan Earthquake in 2011 (M 9.0)

Information on long-period ground motion

Acceleration on the surface of the Earth from JMA acceleration meters

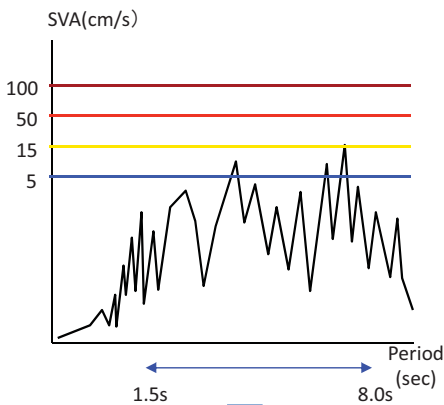


Calculate absolute velocity responses of the periods between 1.5 and 8.0 sec.



Information on long-period ground motion

▶ Decide threshold values which explain each class best.



Intensity scale on long-period ground motion

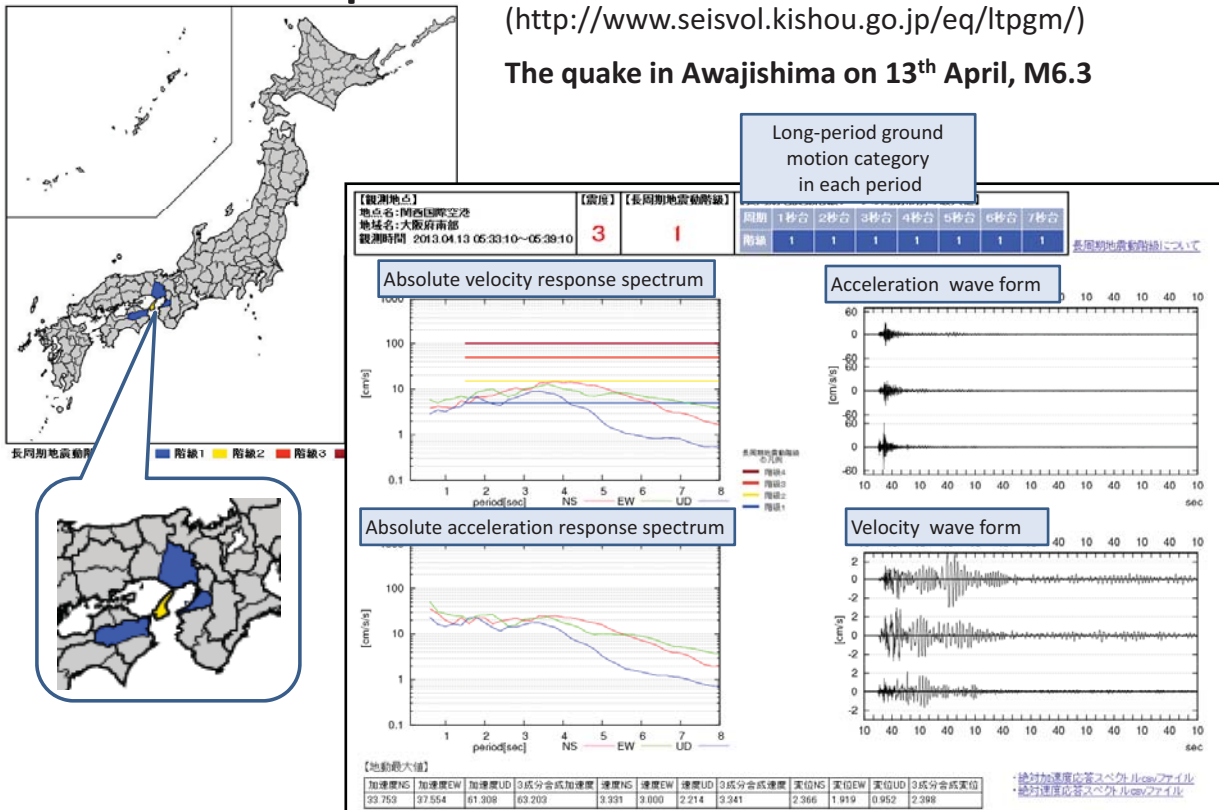
Intensity scale on Long-period ground motion	Effects on people	Indoor situations	Effects on non-structural elements
I 5-15cm/s	Felt by most people in buildings. Some people are startled.	Hanging items such as lamps and blinds swing significantly.	-
II 15-50cm/s	Many people find it difficult to walk without holding onto something stable.	Furniture with caster slightly move. Dishes in cupboards and items on bookshelves may fall.	-
III 50-100cm/s	It's difficult to remain standing.	Furniture with caster move significantly. Unsecured furniture may topple over.	Partition walls may get cracked.
IV 100cm/s-	It's impossible to remain standing and move without crawling.	Furniture with caster move significantly and may topple over. Many unsecured furniture moves and may topple over.	Many partition walls may get cracked.

Information on long-period ground motion

Examples of the JMA web site

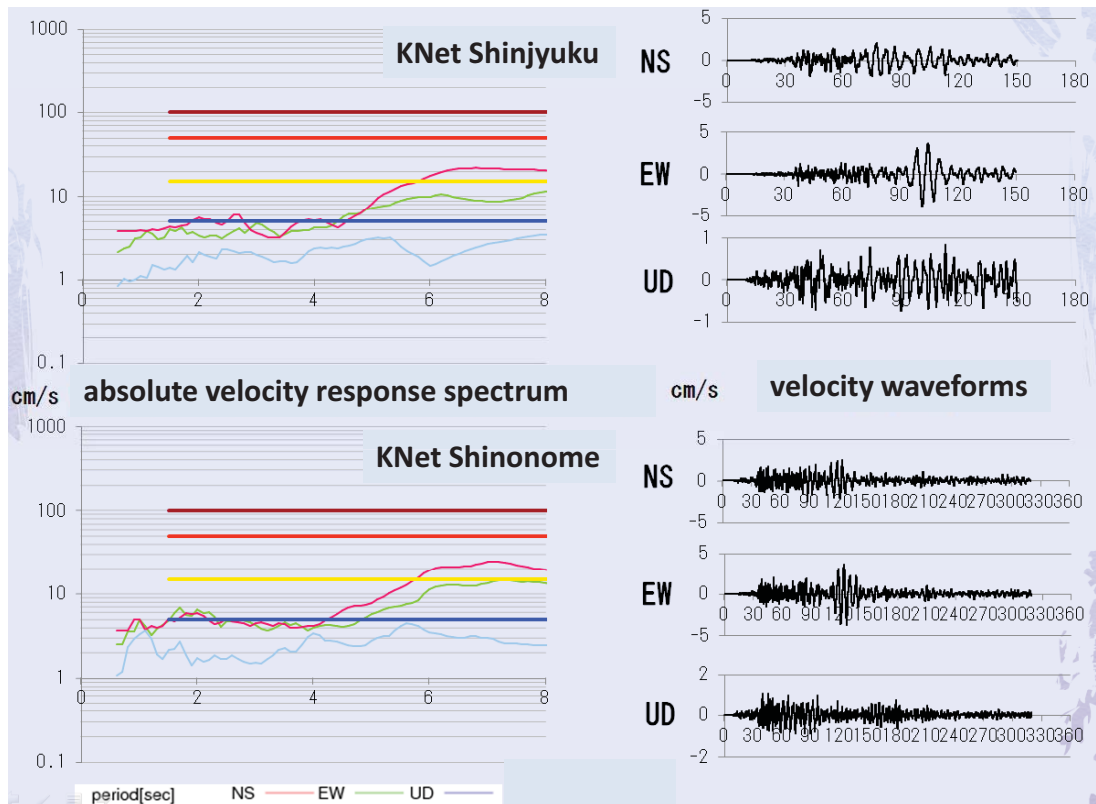
(<http://www.seisvol.kishou.go.jp/eq/ltpgm/>)

The quake in Awajishima on 13th April, M6.3



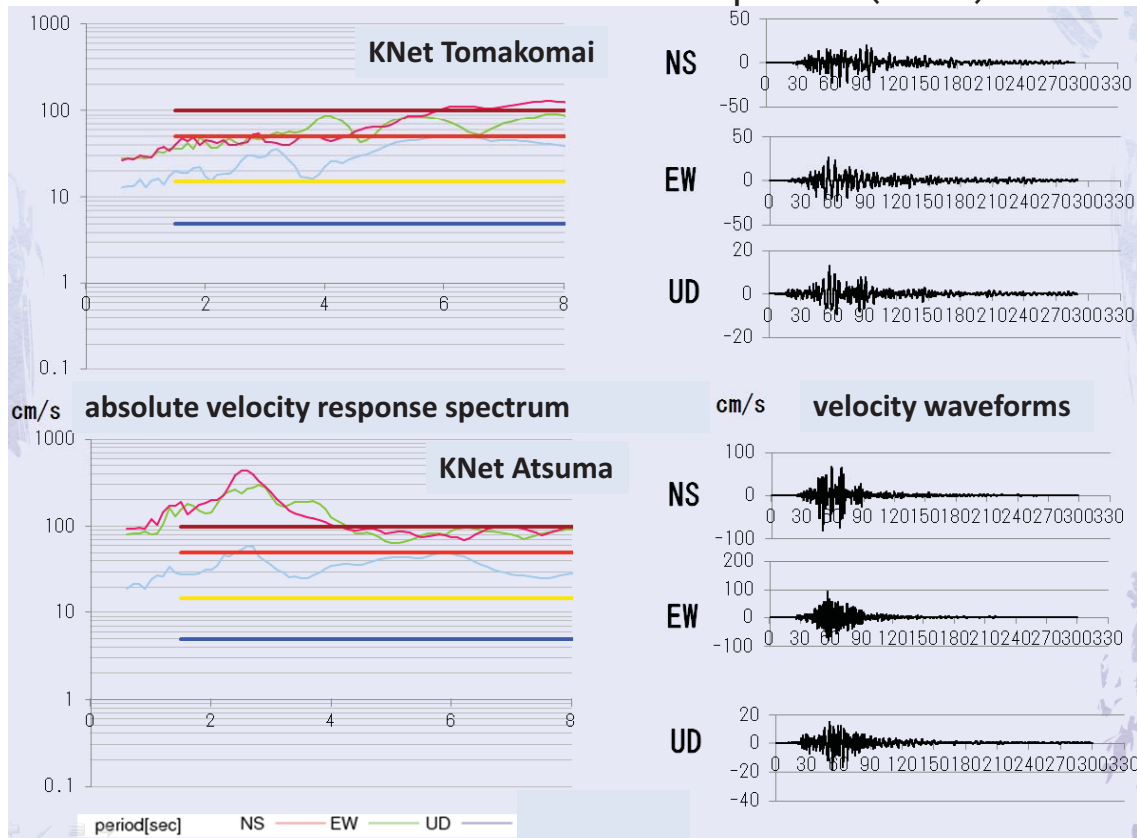
Information on long-period ground motion

The 2004 Niigata Prefecture Chuetsu Earthquake (M6.8)



Information on long-period ground motion

The 2003 Off Tokachi Earthquake (M8.0)



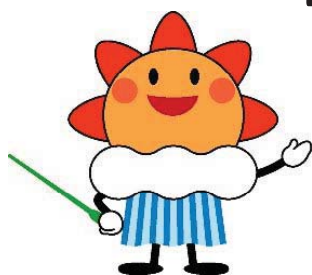
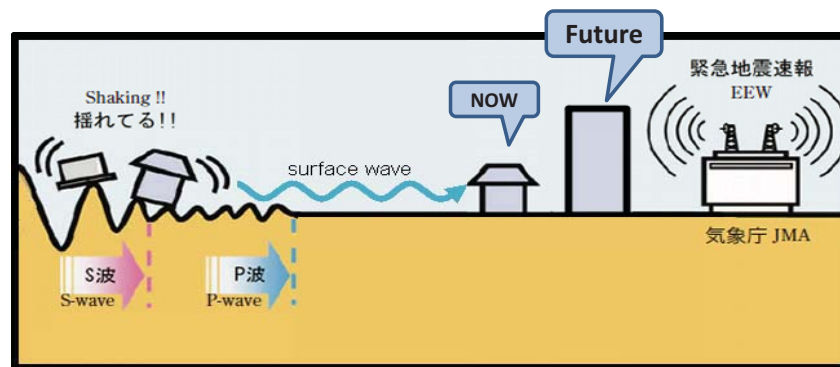
How to use the information

- Building managers can be aware of higher floor's situation.
- Building managers can check some damages if necessary.
- Staffs of the construction companies can judge the possibilities of the structural damages.
- People in high-rise buildings can understand what has happened.



Future plans

- Making efforts to get people recognizing the new information.
- Searching other methods to provide the new information, including mobile phones, TV and radio.
- Investigating long-period ground motion forecast which will function as Earthquake Early Warning for long-period ground motion.



Thank you

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