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Wave period dependence of the tsunami energy decay based on observation: In the case of the 2011 Tohoku-oki Earthquake

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1. Introduction

2011 Tohoku-oki Earthquake caused serious damage. In the case of such a giant earthquake, transportation network suffer serious damage. Therefore ensuring sea route safety as the relief course is important for smooth relief and restoration activity. It is important that realize the decay process of tsunami to early ensure the security of the sea route. On the other hand, there is no clear and scientific standard to judge tsunami convergence (Hayashi et al., 2010).

In this study, we use the 2011 Tohoku-oki Earthquake tsunami wave form and show the characteristic of the tsunami decay process by the connection with time of the moving root mean square amplitude maximum onset and tsunami arrival time. And we paid attention to period, intended to clarify the characteristic of each decrement process.

2. Analysis

We targeted for analysis 20 points chose from observed tsunami wave form in the 2011 Tohoku-oki Earthquake that located in the Japanese Islands Pacific on shore and off shore station (observed by Japan Meteorological Agency, NOWPHAS, Geospatial Information Authority of Japan).

It is obvious that long sampling intervals can lead to a marked distortion of the wave properties (Rabinovich et al., 2011). We unified the sampling intervals for 30 sec and High-frequency filtering was used to remove sea level variations associated with synoptic atmospheric activity. We used the maximum of the moving root mean square amplitude to normalize the observed wave because of tsunami amplitude different from every observation point. After the Normalized process we analyzed that wave form.

Because the tsunami includes wave of various periods, and suggested decay process is different every period (Rabinovich et al., 2013). So we used band-pass 2-16 min, 16-32 min, 32-64 min, and 64-128 min filter to divide tsunami every periods. I calculated the moving root mean square amplitude and we analyzed it with a method of Hayashi et al. (2010) to define a decay coefficient.

In this study, t is the elapsed time from shock, M(t) is moving root mean square amplitude at t, Mmax is maximum of the M(t), Tm is time of onset Mmax, Tt is time of the first wave′s maximum observed, TL is differences between Tm and Tt, k is proportional constant every observation point, e is Napier's constant, τ is decay time. τ mean time required for the average amplitude being decay to 1/e .

As a result of analyzed, the tsunami decrement process of each observation point is characterized by the longer period wave that attenuate later and shorter period wave that maximum wave late for arrival.

3. Conclusion

In this study, we used the tsunami wave pattern at the 2011 Tohoku-oki Earthquake and analyzed it. I discussion a factor to characterize a decay process of the tsunami energy, and get the following result.

(1)Regardless of on shore or off shore, equilateral correlation has τ and Tt, and on shore points tends to get longer than τ.

(2)For a wider tendency, tsunamis indicates that shorter period waves attenuate much faster than longer period waves in a short period.

(3)Some observation point have a long TL about less than 32 min period.

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Keywords: tsunami, decay, decay time, period