Observation of Ocean Bottom Pressure Changes Caused by Short Wavelength Ocean Wave

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Offshore tsunami observations recorded by ocean bottom pressure gauges networks help us to develop real-time tsunami forecast system for disaster prevention (e.g. Yamamoto et al. [2016]) and improve theoretical understanding of tsunami such as confirming the dispersive wave (e.g. Baba et al. [2017]).

In order to compare calculated tsunami height η and observed ocean bottom pressure changes ΔP a simplified relationship $\Delta P = \rho g \eta$ is usually used with incompressibility, hydrostatic approximation and homogeneous water density distribution, where ρ and g are water density and gravitational acceleration, respectively. However, this relation is only satisfied under shallow water model (long wave approximation) because Saito [2010] noticed that the ocean bottom pressure changes ΔP should be smoothed by an amplification $1/\cosh(kh)$. ΔP, therefore, is given by

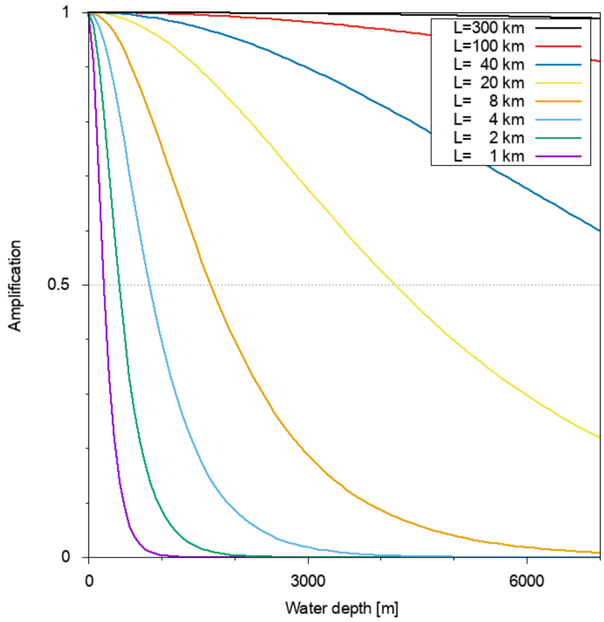

Figure 1. Water depth dependence of ocean bottom pressure changes per wavelength of ocean wave.

$$\Delta P(k,h) = \frac{\rho g}{\cosh(kh)} \eta(k)$$

, where k and h are wave number of sea surface wave and water depth at the location of ocean bottom pressure gauge, respectively.

Under the assumption of shallow water (long wave), this amplification is close to 1 because $kh \ll 1$. On the other hand, under the assumption of short wavelength, the amplification close to 0 and ocean bottom pressure changes ΔP is close to 0. Thus, short wavelength ocean wave has never been recorded on the ocean bottom pressure gauges. The short wavelength tsunami, whose wavelength are several tens of km (blue and yellow curves in Figure 1), are affected this amplification. The shorter wavelength tsunami less than 10 km cannot be observed by deep ocean bottom pressure gauges located on the depth of 6,000 m (orange and light blue curves in Figure 1).

In this presentation, we present that the amplification $1/\cosh(kh)$ is evaluated using meteorological wave such as typhoon. And we report the influence on the tsunami including the short wavelength component known as dispersive wave for the past tsunamis and possible tsunamis in the future.

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