Correction for applying equations on tsunami heights between offshore and coastal tsunami height

*Yutaka Hayashi[1], Takeyasu Yamamoto[1]

1. Meteorological Research Institute

The way of multiplying estimated tsunami amplification to tsunami height obtained at a corresponding offshore point is widely used for forecasting onshore tsunami heights. For examples, scenario-based tsunami databases are often prepared by outputs at a set of offshore sampling points, instead of performing costly tsunami calculations to obtain accurate onshore tsunami heights. In addition, this way is used for updating tsunami forecast based on real-time rapid evaluation of after detection of tsunamis at offshore observatories.
There are several equations on coastal tsunami heights between offshore and onshore points. Among previous equations, there are some practical ones for above-mentioned purposes: Green's law neglecting effects by width of waterway, empirical relations derived from observed tsunami heights by pairs of offshore and onshore observatories (e.g. Hayashi(2016, JpGU)), and experimental relations derived from calculated tsunami heights at off- and onshore sampling points.
However, sampling points are often affected by overlapping waves such as a direct wave and reflected one at a shore, and refraction of ray paths caused heterogeneous water depth. If an offshore tsunami height is sampled near a loop of overlapped wave, it tends to be larger than the spatial average near sampling points. And tsunami heights obtained near nodes tends to be smaller than spatial average of the area of concern.
From the theoretical consideration on superposition of a long wave and its imperfect reflected wave, we defined the corrected offshore maximum tsunami height as $H^*=((H_{max}{}^2+(h/g)*V_{max}{}^2)/2)^{1/2}$, where H_{max}, V_{max} , h, and g are the maximum tsunami height, maximum velocity, water depth at a sampling point, and gravity acceleration, respectively. In applying to equations on coastal tsunami heights between offshore and onshore points, using H^* instead of H_{max} can reduce influences by the location of a sampling point, because H^* has been defined so that it is equal to the root mean square of H_{max} through one wave length.

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