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The tsunami wave was amplified at bays in the ria-coast ? ?amplification of tsunami in the bay?

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We investigated the tsunami amplification of the 2011 Tohoku earthquake at the bays in the ria-coast of Sanriku area, northeast Japan. The amplification of tsunami wave in the ria-coast type bay occurs by the concentration of tsunami wave, and by the oscillation in the bay as a result of the periodic arrivals of the tsunami waves. The amplification factor, which is the ratio of the wave height at the head of the bay to wave height at the bay mouth, depends on the oscillation of bay and the period of tsunami wave (Abe, 2005). The amplification factor at the long-period oscillation type bays (>30 minutes) was in the range of 0.3?0.5 for the 1896 Sanriku tsunami and 1933 Sanriku tsunami. These reached at the range of 2?3 for the 1960 Chilean tsunami. The amplification factors of the short-period type bays were at the range of 1?3 for those tsunamis.

We observed the inundation heights at the bays from south of Iwate prefecture to north Miyagi prefecture on April 20-23, 2011. The oscillation period of the bays were classified to long-period type (Ohunato bay (46 minutes), Hirota bay (52 minutes), and Kesennma bay (52 minutes)) and short-period type (Kippama bay (12 minutes) and Okirai bay (10 minutes)) (Abe, 2005). We measured the inundation height at the steep slope to avoid the effect of runup and estimate the heights of tsunami wave.

The observed amplification factors were at the range of 1.5?2.0 at the short-period type bays (Okirai bay and Yoshihama bay). Those were almost 1.0 at the long-period bays (Ohunato bay, Hirota bay, and Kesennuma bay).

The obtained results are consistent with those of the previous tsunami at the short-period bays, although these are inconsistent with those at the long-period bays. The no amplification at the long-period bay would be caused by the near-field magnitude 9 earthquake: the long wave periods of tsunami (about 40 minute from the GPS tsunami measurement system at Kamaishi) and prominent wave height of the first wave (6.5m for the first wave, and two meter for the later waves).

Keywords: tsunami, 2011 Tohoku Earthquake