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Relationship between tsunami heights at offshore and coastal points in the Sea of Japan

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Several large (M>7.5) earthquakes occurred along the eastern margin of the Sea of Japan and caused tsunami damage in Japan as well as on Korean peninsula in the last two centuries. They were the 1993 Southwest Hokkaido (Mjma 7.8), 1983 Japan Sea (Mjma 7.7), 1964 Niigata (Mjma 7.5), 1940 Shakotan-oki (Mjma 7.5), and 1833 Shonai-oki (M 7.5) earthquakes.

In order to assess possible future earthquakes and tsunamis, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan recently identified 60 submarine active faults with lengths ranging from 24 to 162 km (corresponding moment magnitudes of 6.8 to 7.9).

Tsunami inundations in Aonae Bay, Okushiri Island, Japan on high-resolution bathymetry and topography data were simulated using the active fault models. For small tsunamis (coastal tsunami heights <4 m), the relationship between tsunami heights in the offshore (50 m depth) and at the coast follows a linear regression line, whereas for larger tsunami the linear relationship may not hold. The regression line gives an amplification factor of 3.5 to roughly estimate coastal tsunami height from a tsunami numerical simulation result on a coarse grid system.

We computed offshore and coastal tsunami heights along the Japanese coasts from these 60 faults and identified faults that may possibly cause tsunami damage (coastal tsunami heights >1 m) for 156 municipalities (cities and towns). Comparisons between offshore and coastal tsunami heights show that the ratios vary from place to place, and seem to be controlled by the bathymetric slope.

Keywords: Tsunami simulation, Tsunami inundation, Active faults, The Sea of Japan