ABSTRACT

The long wave caused by earthquake, landslide or volcanic eruption can be propagated over the global ocean. The 1883 Krakatau volcanic eruption has generated a destructive tsunami higher than 40 m on the Indonesian coast where more than 36,000 lives were lost. Sea level oscillations related with this event have been reported on significant distances from the source in the Indian, Atlantic and Pacific Oceans. The 2011 Tohoku earthquake triggered extremely destructive tsunami waves which propagated over the Pacific Ocean, Atlantic Ocean through Drake Passage and Indian Ocean respectively. These transoceanic tsunamis are propagated to Antarctica and the impact of 2011 tsunami waves on the icebergs in Sulzberger is captured by satellite images. The worldwide propagation of the tsunami waves is studied numerically using two conventional models: ray tracing method and two-dimensional linear shallow-water model.

KEY WORDS: Transoceanic tsunami propagation; Krakatau Tsunami; 2011 Japan tsunami.

INTRODUCTION

The 1883 Krakatau volcanic eruption has generated a destructive tsunami higher than 40 m on the Indonesian coast where more than 36,000 lives were lost. (Fig. 1) Choi et al. (2003) simulated the tsunami wave propagation from the Krakatau volcanic eruption and performed the numerical simulation of the tsunami waves on globe using the detailed bathymetry of the World Ocean. Sea level oscillations related with this event have been reported on significant distances from the source in the Indian, Atlantic and Pacific Oceans (Fig. 2). It can obtain more rigorous estimates of the tsunami travel time, clarify the role of the tsunami pathways through the Antarctic basin, and compare the wave characteristics in different areas. Various descriptions of tsunami wave manifestation (both, eyewitness and tidegauge records) and corresponding scientific accounts are collected by Simskin and Fiske (1983).

The 2011 Tohoku earthquake, recorded to be 9.0 in magnitude, came about as a result of an undersea mega-scale thrust off the Pacific coast of Japan. The earthquake triggered extremely powerful tsunami waves with a maximum run-up height of about 37.9 m that hit the Japanese Pacific-side coast minutes after the quake, in some cases inundating up to 10 km inland. Tsunami waves with smaller heights reached many other countries after several hours, affecting at least 20 countries, including most Asian countries in the western Pacific region, Australia and the entire Pacific coast of the American continent (Fig. 3).

NUMERICAL CALCULATIONS OF THE TSUNAMI PROPAGATION

Ray Tracing Method

The worldwide propagation of the tsunami waves is studied numerically using two conventional models: ray tracing method and two-dimensional linear shallow-water model. Calculation of the tsunami travel time for the tide-gauge locations and the direction of propagation are performed in the framework of the ray tracing method (Choi et al., 2003). The ray tracing method is usually used as a short wavelength