Simulation of Potential Tsunami Hazard in the South China Sea for Assessing Impact on South China

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ABSTRACT

Since 2004 Indian Ocean tsunami, the potential tsunami hazard from Manila trench has been highlighted of concerns by the countries surrounding the South China Sea. In this paper, we focus on the impact of potential tsunami hazard on southern China based on numerical method as well as theoretical analysis. A tsunami scenario induced by a hypothetical earthquake in the Manila Trench is simulated by using a finite-difference model based on nonlinear shallow-water equations. It is found that southern China is possible to be severely affected by tsunami waves. The coastal regions of southern China can be attacked in 2.5~4 hours after the deformation of the plate. For the hypothetical case of Mw 9.0 earthquake, the maximum surface elevation will reach 300cm and the current speed can reach several m/s. Considering the local tsunami amplification over the shelf-break and shelf, the results could be more disastrous. Further research and monitoring of the tsunamis in this area are urgent and necessary.

KEY WORDS: Earthquake tsunami; numerical simulation; COMCOT; Manila Trench; South China Sea; Southern China.

INTRODUCTION

As one of the most devastating natural disasters faced by human beings, tsunami has been paid more and more attention and researches in recent years, especially after the devastating Indian Ocean tsunami in 2004. A tsunami is a very long-wavelength wave of water that is generated by sudden displacement of the sea floor or disruption of any body of standing water (Helal and Mehanna, 2008). It can be triggered by various sources like submarine earthquakes, submarine landslides, volcano eruptions, and even nuclear explosions or asteroid impacts (Satake and Atwater, 2007). Most tsunamis are generated by shallow large earthquakes in subduction zones (Satake and Tanioka, 1999). Generally speaking, hazardous tsunamigenic earthquakes have three characteristics in common: first, the water depth at the source region is deep and the topography varies sharply; second, the earthquake intensity is no less than MW 6.5 and the fault motion is mainly in vertical direction; third, shallow earthquake with the focal depth less than 50Km (Wang, Liu and Zhang, 2005; Yang and Wei, 2005).

China is a large continental country with a long coastline and has heavy population in the coastal area; hence it is urgent and important to evaluate tsunami risk. This has become even more crucial considering the intensive growth of harbors and the expansion of coastal cities. Nuclear power industry has been encouraged and developed vigorously in China these years. The nuclear reactors are mostly built along the coastal areas of southern China, which also justifies the necessity to assess the impact of potential tsunami hazard on southern China coast areas.

For Chinese coastal areas, three zones are normally regarded as high risk regions for tsunami generation: the South China Sea, the adjacent sea area of Taiwan and the margin of the continental shelf of East China Sea (Zhou and Adams, 1988; Guo An-ning, 2005; Mak and Chan, 2007; Wen, Zhu, Song, Li and Liu, 2008). Zhou and Adams (1988) divided the coast of China into zones of tsunami risks, and regarded the South China Sea as the zone of the highest risk. Yang and Wei (2005) analyzed the sea floor topographic feature, geological setting, seismicity and tsunami history in the South China Sea and held that the Manila Trench located on the eastern boundary of the South China Sea was a potential region of earthquake tsunami. The Manila subduction zone west of Philippine has been identified as the most hazardous tsunami source region and made numerical researches to evaluate the possible impact of the tsunami waves (Liu, Santos, Wang, Shi, Liu and Yuen, 2007; Huang, Wu, Tan, Megawati, Shaw, Liu and Pan, 2009; Liu, Wang and Salisbury, 2009).

In this paper, the topographic feature, geological setting and seismic activity of the South China Sea as well as historical tsunamis are analyzed in order to evaluate the possible tsunami hazards from potential earthquakes in South China Sea. Then numerical simulations for tsunami cases of potential earthquakes coming from the Manila Trench are made to investigate the physical characteristics of the tsunami waves in South China coastal areas.

POTENTIAL TSUNAMI RISK ANALYSIS IN THE SOUTH CHINA SEA

The wide and flat continental shelf and a series of islands or