Modeling scenarios of earthquake-generated tsunamis for the Vietnam coasts

Antonella Peresan, Fabio Romanelli, Franco Vaccari, Davide Bisignano, Giuliano F. Panza

Department of Geosciences, University of Trieste, via Weiss 4, 34127. Trieste – Italy.
E-mail: aperesan@units.it
The Abdus Salam International Centre for Theoretical Physics, ICTP SAND Group. Trieste – Italy

Cao Dinh Trieu, Nguyen Huu Tuyen, Le Van Dung, Pham Nam Hung, Mai Xuan Bach, Nguyen Hong Phuong

Institute of Geophysics, Vietnam Academy of Science and Technology (VAST)

A wide set of direct and inverse problems in seismology may significantly benefit from advanced e-infrastructures and computational capability, with the aim to improve the current understanding of the Earth structure and dynamics and to allow for a physically sound, scenario-based assessment of seismic and tsunami hazard.

Modeling a hazard scenario has the main purpose to assess the maximum threat expected from a studied phenomenon in a certain area and to give specific directives to the local authorities in order to prevent and mitigate serious consequences on the population, the infrastructures and the environment. To build scenario-based tsunami hazard maps for a specific coastal area one has first to characterize the seismic sources (or other tsunamigenic events, not considered in this study) and select the earthquake scenarios that can drive the hazard. By means of the modeling we then calculate, among others, the maximum amplitude of the vertical displacement of the water particles on the sea surface and its travel time, since they are the most relevant aspects of the tsunami wave always reported in the chronicles and therefore recorded in the catalogs.

In this study, originated by a MAE - MOST bilateral collaboration project, our modeling method is applied to compute earthquake generated tsunami hazard along the Vietnam coast. This zone can suffer the tsunamigenic action of Manila Trench, where strong earthquakes are likely to occur. In particular we have considered the extreme scenario of a magnitude 9 earthquake and our results indicate that in this case a tsunami with maximum amplitude up to ten meters could hit Vietnam. We have computed tsunami waves also from other sources in the western and central part of South China Sea; this zone is not so

well studied as Manila Trench and being close to coasts it can represent another relevant source of hazard.

Considering the low level of tsunamis monitoring in the South China Sea and the rapidly expanding anthropization of the very vulnerable Vietnam coasts, the results of modeling can be used as a preliminary knowledge basis to (a) design early warning systems, (b) reduce tsunami risk and (c) plan land-use for the Vietnam coast.

A number of very active international collaborations, focused on the mentioned scenario-based approach to seismic and tsunami hazard assessment as well as on a broader set of geophysical problems, are ongoing since several years in the framework of the Scientific Network "Seismic Hazard in Asia", which involves several countries, like China, Vietnam, Nepal, India, Bangladesh, Pakistan and Philippines. The efficiency of the modeling and its impact on mankind and infrastructures for disaster prevention purposes can greatly benefit from the availability of Grids and Clouds computing. Such facilities enable us the computation of a wide set of synthetic mareograms, dealing efficiently with variety and complexity of the potential tsunamigenic earthquake sources, and the implementation of parametric studies to characterize the related uncertainties. Advanced scientific and computational tools and networking would permit a widespread application of the proposed approach and would allow for a faster development and verification of the models.