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STUDY ON TSUNAMI FLOOD OCCURRENCE DUE TO MAKRAN SUBDUCTION ZONE (CASE STUDY BERRIES)

Shahmir . Eghtesadi[1] . Behzad . Layeghi[2]

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introduction

Numerical modeling of tsunami is very important for understanding past phenomena and simulation of predicted future events. However consideration of the processed data based on past events is necessary but not sufficient. A suitable scientific method would be to use numerical modeling for determining flood and run up based on local or offshore tsunami. In 1945, a Tsunami had occurred in Pakistan which was a useful warning hint for possible dangers for the Oman Sea coastal areas. The quantity of tsunami induced by subduction zone earthquake depends on different factors such as magnitude, source geometry and location. Magnitude and source geometry of earthquake determine surface disturbance which will assess size and length scale of tsunami. Source geometry should be calculated from practical formula that considers fault length, width, slope and the time of accident. In this research, COMMIT[3] was used which is a common internet-based interface for tsunami. This tool is developed by National Center of Tsunami Research (NCTR).

Flood modeling was done for coastal regions of Iranian province of SISTAN AND BALUCHESTAN to assess size and length scale of tsunami and finally find out the effects of tsunami that is induced by a probable earthquake in subduction zone. The secondary goal of this study is to determine maximum wave height on coastline of SISTAN AND BALUCHESTAN Province.

Methodology

Numerical modeling is a useful for simulation of tsunami both on coastal region and deep water, as well as for wave propagation on affected area and flooded area. In this part of study several tools has been used. These tools consists of following: the MOST model (a Method for Splitting Tsunami) which is prepared by Titov on behalf of PMEL and Sinolakis on behalf of south California university, and a graphical interface COMMIT to produce the simulated tsunami, wave propagation toward affected area and throughout the flooded region. High resolution bathymetric grids are needed to reproduce verified model of wave dynamics throughout flood calculation. Three grids of A, B and C has been used, so that C is a subset of B and B is a subset of A. The scales and resolution of these grids have been defined in table 1.

[1]Assistant pro, OASC, seghtesadi@gmail.com
[2]PhD Student, OASC, layeghi2001@yahoo.com
[3] Common Model Interface for Tsunami

Table 1: specifications of modeling grids

MOST operation steps	Grid resolution
Grid A	1 arc min(1800 m)
Grid B	8 arc sec(240 m)
Grid C	1 arc sec(30 m)

According to above resolutions, structure of model grids was defined and prepared for next steps. The boundaries of different model grids have been determined in fig. 1.

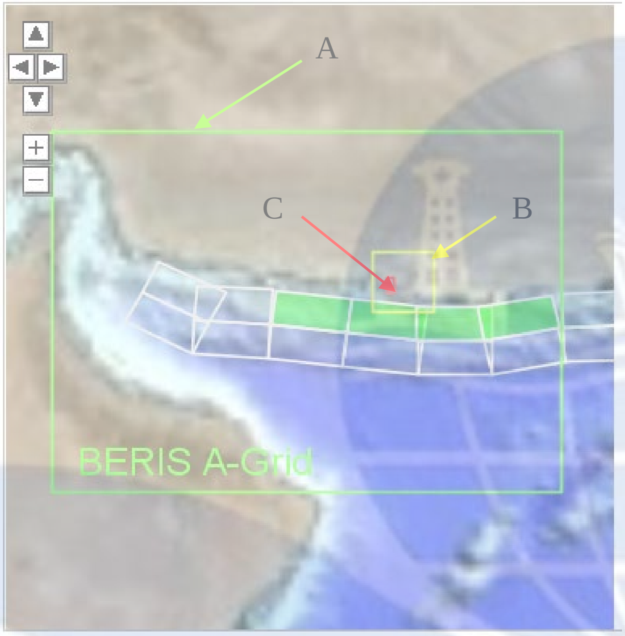

Fig. 1: Grids A, B and C of MOST model

The Bathymetry data used in the model is the 2 minutes ETOPO2 global data prepared by National Center of Geophysical Data and can be find at following url:
http://sift.pmel.noaa.gov/grid/
The Isobaths map of grid A has been shown in fig. 2.

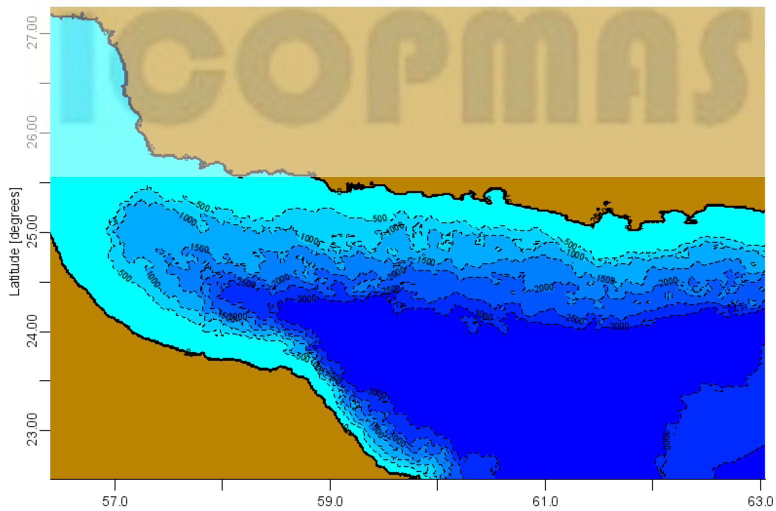

Fig. 2: Oman Sea isobaths related to grid A

In this research, the earthquake source was considered as time step of 0.2 sec (using CFL condition).

conclusion

The results were tested by 8, 8.5, and 9 Richter earthquake and 1.4 m, 7.9 m and 44.35m fault vertical displacement. Because of vicinity to Beris coastal zone, the run time duration was chosen for 2 hours. The first wave was expected to arrive to Beris coast within 20 minutes. Therefore the maximum flood of MOST model was up to 9 Richter and is shown in fig. 3. Maximum flood width would be 1.4 km and maximum flow depth would be 5m. In fig. 3, the distribution of run up has been shown on land region.

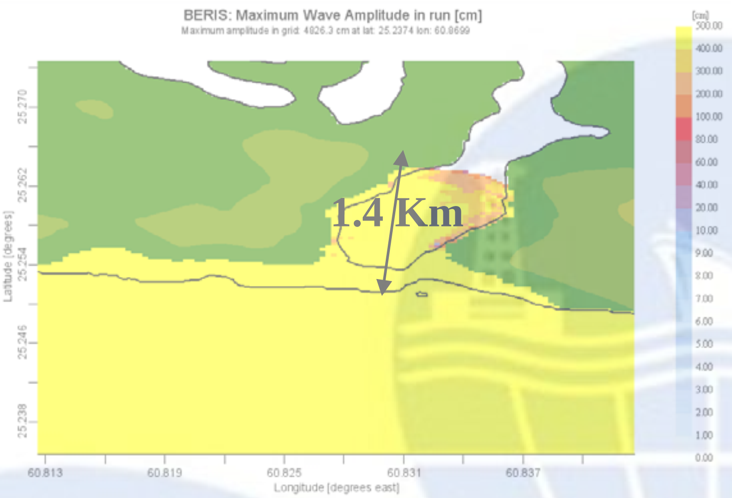

Fig. 3: Maximum flood of tsunami induced by a 9 Richter earthquake

Maximum run up of a 8 Richter earthquake should be around 0.5m, a 8.5 Richter should be around 3.4 m and a 9 Richter should be around 14 m. The maximum duration of probable tsunami on the region could be estimated around 2 hours and 30 minutes. It has been shown in fig. 4.

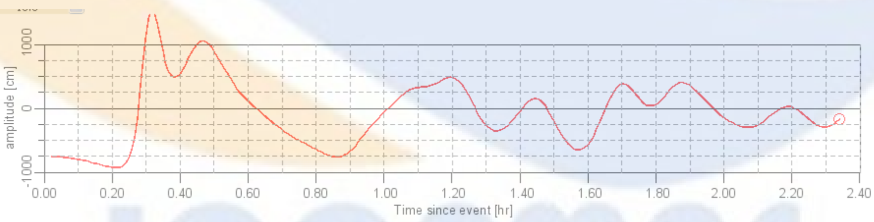

Fig. 4: Maximum wave height in Beris coastal zone (land)

According to the results in different scenarios given by MOST model, the following items can be concluded:

- based on the results of simulation, the maximum earthquake in the region is 8.5 Richter, maximum flood is not significant and doesn't make great danger. But if a 9 Richter earthquake (Japan earthquake, 2010) occurs in Makran subduction zone, there would be great destruction in the residential and industrial sections.
- by considering the arrival time of the first tsunami waves (22 min), there is no time for broadcasting a warning for people. Therefore the residential and industrial structure would be in danger at the distance of 1.4 km far from coastline.

Based on above results, there are some suggestions:

- more accurate bathymetry data should be prepared for more accurate decision during crisis.
- by applying these results in GIS layer format, it could be possible to determine high risk regions to optimize development planning.

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