Geophysical Research Abstracts
Vol. 13, EGU2011-10355, 2011
EGU General Assembly 2011

Pre-defined earthquake source mechanism parameters for Tsunami Early Warning in Mediterranean Region

Ergin Ulutas (1) and Alessandro Annunziato (2)

(1) Department of Geophysical Engineering, Kocaeli University, Kocaeli, Turkey (ergin@kocaeli.edu.tr/+90 262 3033003),
(2) Institute for the Protection and the Security of the Citizen, EC-Joint Research Center, Ispra, Italy
(alessandro.annunziato@jrc.ec.europa.eu/+39 0332 785154

Short tsunami arrival times especially require a possible earthquake source parameters data on tectonic features of the faults like strike, dip, rake and slip in order to minimize real time uncertainty of rupture parameters. Indeed the earthquake parameters available right after an earthquake are preliminary and are in general not enough. Determining which earthquake source parameters would affect the initial height of tsunamis show the sensitivity of the maximum tsunami heights and tsunami time series along the coastal regions. Therefore, tsunami generation models should be performed according to the seismotectonics properties of the different regions. In order to do this, the geometries of the tsunamigenic sources have been examined to understand the effect of fault geometry and depths of earthquakes in Mediterranean region. The source mechanism parameters, spatio-temporal slip distributions of the historical earthquakes and historical tsunami wave propagations from the previous studies have been compiled (Taymaz et al., 1991; Tinti et al., 1999; Tinti et al., 2005; Papaioannou and Papazachos, 2000; Vannucci et al., 2004; Meirer et al., 2004; Moratto et al., 2007; Pondrelli, 1999, Yolsal et al., 2007; Lorito et al., 2008).

Any type of initial conditions for the tsunami simulations may create a different sea wave pattern. The simulations can be modeled only when the fault mechanism solutions (magnitude, strike, dip, rake, depth) available few hours after an earthquake by the data providers such as United States Geological Survey (USGS), European Mediterranean Seismological Center (EMSC) and etc. However, there are two possible fault planes that are defined by strike, dip and rake. The fault plane responsible for the earthquake is parallel to one of the nodal planes, the other being called the auxiliary plane. Unfortunately it is not possible to determine solely from a focal mechanism which of the nodal planes is in fact the fault plane. One of the planes is the fault surface while the auxiliary plane has no structural significance. The tectonic and geological evidences are needed to differentiate between the two possible fault-plane solutions. In this study, a new dataset with one fault plane parameters for every grid point has been defined. It is planned to use them for JRC Tsunami Forecast Propagation Database of in the Mediterranean Sea. The new dataset will be included in the calculation scheme and it will be used to prepare the pre-calculated scenario database in order to explore and quickly retrieve tsunami arrival times and maximum heights from the database.

In order to test the new database, three historical worst case scenario tsunamis, 1222 Paphos, 1303 Crete and 1908 Messina tsunamis, were chosen to calculate tsunami heights along the coastal regions in Mediterranean Sea. The earthquakes are the largest and best-documented seismic events in the history of the Mediterranean area. The effects of the earthquakes and associated tsunami waves were very destructive. It is shown that in the worst case scenario tsunami of 1303 Crete earthquake, the maximum heights may reach 3 meters near the Crete, 1 m Southeast of Turkey, 1 m Egypt and Lebanon. It is shown that in the second worst case scenario tsunami of 1222 Paphos earthquake, the maximum heights may be 1.5 meters near the Cyprus, 0.2 meters Egypt, Israel and Lebanon. Due to the earthquake parameters of 1908 Messina earthquake, South of Calabria and Northeast of Sicily experienced waves with heights 1-1.5 m. The calculations are compared with the expected values from the scenario database to show that the database solutions can give a reasonable good estimate of the 'real' cases; also the study will identify the expected time trends at the locations of the currently available sea level measurements in the Mediterranean sea in order to check whether enough time is available for early warning.

References:

Lorito.S., Tiberti. M.M., Basili. R., Piatanesi. A., Valensise. G. 2008. Earthquake-generated tsunamis in the Mediterranean Sea: Scenarios of potential threats to Southern Italy. Journal of Geophysıcal Research. 113, B01301, doi:10.1029/2007JB004943

Meier, T., Rischea, M., Endrun, B., Vafidis, A.,Harjes, H.P., 2004. Seismicity of the Hellenic subduction zone in the area of western and central Crete observed by temporary local seismic networks, Tectonophysics 383, 149– 169.

Moratto, L., Sikora, B.O., Costa, G., Suhadolc, P., Papaioannou, Ch., Papazachos, C.B., 2007. A deterministic seismic hazard analysis for shallow earthquakes in Greece. Tectonophysics, 442, 66–82.

Papaioannou, Ch.A., Papazachos, B.C., 2000. Time-independent and time-dependent seismic hazard in Greece based on seismogenic sources. Bull. Seism. Soc. Am. 90, 22–33.

Pondrelli, S., 1999. Pattern of seismic deformation in the Western Mediterranean, Annali di Geofisica, 42, 57-70.

Taymaz, T., Jackson, J., McKenzie, D., 1991. Active tectonics of the north central Aegean Sea. Geophys. J. Int. 106, 433–490.

Tinti, S., Armigliato, A., Bortolucci, E., Piatauesi, A., 1999. Identification of the Source Fault of the 1908 Messina Earthquake through Tlsunami Modelling. Is it a Possible Task?, Phys. Chem. Earth(E), 24, 417-421.

Tinti, S., Armigliato, A., Pagnoni, G., Zaniboni, F., 2005. Scenarios Of Giant Tsunamis Of Tectonic Origin In The Mediterranean, ISET Journal of Earthquake Technology, 42, 171-188.

Vannucci, G., Pondrelli, S., Argnani, A., Morelli, A., Gasperini, P., and Boschi, E., 2004. An atlas of Mediterranean seismicity, Annals of Geophysics, 47,247-306.

Yolsal, S., Taymaz, T and Yalciner, A.C., 2007. Understanding tsunamis, potential source regions and tsunami-prone mechanisms in the Eastern Mediterranean, Geological Society, London, Special Publications, 291, 201-230.