The Need for a Decision Support System in Tsunami Early Warning Practice in case of Near-shore Sources

Stefano Tinti, Alberto Armigliato, Gianluca Pagnoni, Filippo Zaniboni
Department of Physics, University of Bologna
Bologna, Italy

ABSTRACT
From a Tsunami Early Warning System (TEWS) design perspective, this paper presents few theoretical cases of earthquake- and landslide-generated tsunamis in western Iberia and in the eastern Mediterranean, with the aim of discussing the need for a Decision Support System integrating suitable real-time sensor networks of different types and a properly-designed knowledge-based archive of scenarios. The advantages of this type of approach over simpler tools, such as Decision Matrices, are briefly discussed.

KEY WORDS: Tsunami, Tsunami Early Warning System, Decision Support System, Decision Matrix.

INTRODUCTION
The basic criterion to judge whether a Tsunami Early Warning System (TEWS) works properly or not resides in its ability to send proper warnings and/or alerts in a suitable time to all the countries and communities that can be affected by the impacting tsunami waves. In other words, the proper warning messages must be sent in a proper time to properly identified threatened coastal regions. Time is an extremely critical parameter especially when the tsunami sources are placed close to the shore. In this case, all the components of the TEWS, namely the sensor environment, the tsunami source characterization, the tsunami potential assessment and the selection of the warning/alert messages and of the targets, must react within a time window that is typically limited to few minutes. Solving such a challenging issue is particularly urgent in Europe and in the Mediterranean Sea, where the tsunamigenic sources are located near-shore.

The Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS) has proposed the adoption of the so-called “Decision Matrix” (DM). It is a simple tool applicable only to tsunamis generated by earthquakes: based only on the preliminary estimations on the earthquake magnitude and hypocenter location, the DM establishes whether a warning should be issued and the type of warning to be issued. The problem with the DM is that it cannot be applied to tsunamis generated by landslides, which are relatively frequent in the Mediterranean and in the European seas. The DM might also fail when a moderate-magnitude earthquake triggers a landslide that in turn triggers a tsunami. Finally, the DM takes in no consideration the focal mechanism of a given earthquake, which plays a basic role in the tsunamigenic potential of the earthquake itself.

The EU-FP7 TRIDEC Project aims at developing a Decision Support System (DSS) based on an archive of simulations (knowledge-based archive) dealing mainly with seismic sources but with some attention devoted also to landslides, and on an integrated set of seismic, geodetic and marine sensors. In the frame of TRIDEC, two test areas in the Euro-Mediterranean region are taken into consideration in this paper, namely the western Iberian margin and the eastern Mediterranean Sea. In the first area, this study concentrates on the Gorringe Bank zone and simulates numerically three different tsunami scenarios: a parent earthquake with magnitude 7.5, one with magnitude 8.5, and one with magnitude 7.5 that triggers a large-volume landslide. In the eastern Mediterranean, a rather peculiar situation is taken into consideration when, due to the tectonic environment, a given hypocenter location and magnitude can refer to a strike-slip or to a pure thrust fault. In both cases, the relevant features of the different tsunamis are studied and the performance of the NEAMTWS DM is analysed. Moreover, it is suggested how the TRIDEC platform could be successful in dealing with each of the above-mentioned situations, including the architecture of the knowledge-based archives and the optimal configuration of different kinds of monitoring sensors.

THE NEAMTWS DECISION MATRIX
The design and implementation of proper TEWSs has become a topic of worldwide interest after the disastrous Indian Ocean tsunami of 26th December 2004. Even though that event produced large impression on the public opinion for its capacity of determining damage and deaths at trans-oceanic distances, a key point that one should always keep in