UPDATE ON THE MALTA SEISMIC NETWORK

Agius, M.R., Galea P., D'Amico S.
Seismic Monitoring and Research Unit, Department of Geosciences, Faculty of Science, University of Malta, Msida, Malta.

Introduction

The Central Mediterranean is one of the most seismically active and tectonically dynamic regions in the Mediterranean characterised by a system of extension in the north (Appenines), a slab rollback in the centre (Calabria) and a rift zone in the south (Sicily Channel), all within a general convergent setting between the African and European plates. Unlike the northern regions of the Central Mediterranean (and others such as along the Hellenic subduction zone), earthquake monitoring within the Sicily Channel has, so far, been inadequate. During the last two years the Seismic Monitoring and Research Unit (University of Malta) has been upgrading its earthquake monitoring capabilities, with the addition of new broadband seismic stations and state-of-the-art real-time monitoring. The new setup will not only help to investigate better the regional seismicity within the Sicily Channel, but will also facilitate early warning of potentially felt earthquakes originating hundreds of kilometres away from Malta. This investment is part of the project SIMIT (B1-2.19/11) funded by the Italia-Malta Operational Programme 2007–2013.

Seismic network and instrumentation

A seismic network code for Malta (ML) has been registered with the International Federation of Digital Seismograph Networks (FDSN). The new network will consist of 3 permanent, broadband seismographs: the current station WDD (Agius et al., 2014), which is located in the south of Malta and part of the MEDNET (MN) program (Boschi and Morelli, 1994), and 2 new stations: one located on the island of Gozo and one located in the centre of the island of Malta. The new stations will help to improve the detection and location of local and regional earthquakes in general, and in particular earthquakes occurring close to the Maltese islands. The new seismographs consists of a Trillium 120 PA broadband seismometer and a Centaur-3 digital seismic acquisition system, both manufactured by Nanometrics. Real-time data will be transmitted to SMRU using the SeedLink protocol and redistributed to international data centres. The TCP connections will be managed through the SeisComP software. Another broadband seismometer, a Trillium Compact 120 s, is also available as a portable station. This roving station, which can be powered by solar energy or a car battery, will be used for site effect studies and local geophysical investigations.

Site selection

Various sites have been considered for the permanent selection to house the seismographs. Each site underwent an initial H/V spectral ratio analysis. This gives an indication of the suitability of the site in terms of the underlying geology. Other considerations were the permanent housing permits and reliable electrical power and internet connections. A number of sites have been selected for a prolonged investigation on the seismic data quality. The data from each temporary deployment was used to study recorded earthquake seismograms and to analyse the seismic ambient noise levels of the site. These were then compared with the data of the current permanent seismic station WDD. One of the preferred sites is at the University of Malta, Msida Campus (MSDA). A vault has been constructed to house the seismic station on top of Lower Globigerina Limestone. Figure 1 shows examples of recorded earthquakes at the site of MSDA, power spectral analysis to assess the noise levels, and a picture of the vault.

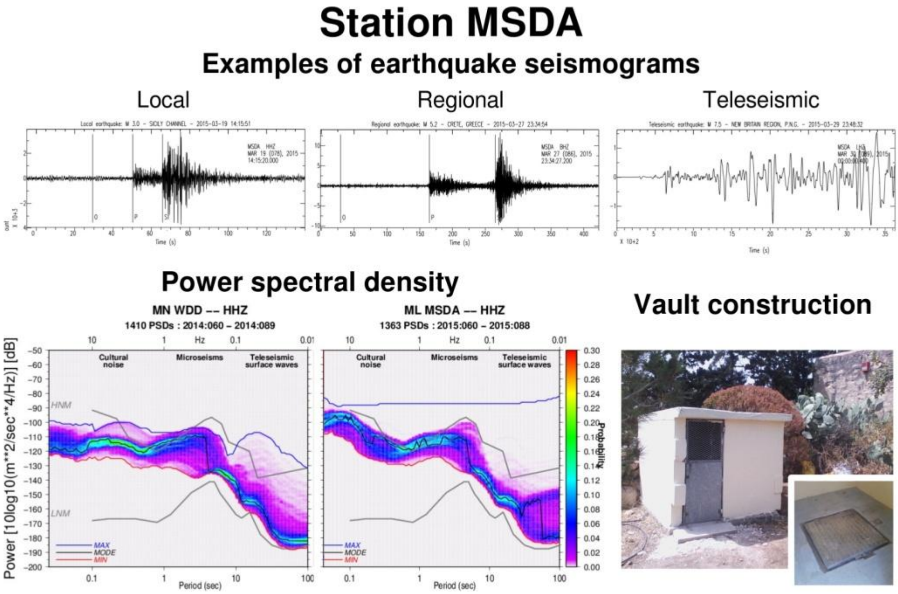

Figure 1. Earthquake seismograms, spectral analysis and vault construction of seismic station MSDA. Top: Examples of earthquakes recorded at MSDA that are typically registered at other nearby stations in the Central Mediterranean: local (≤100 km): Sicily Channel; regional (≤1000 km): Crete, Greece; and, teleseismic (>1000 km): Papua New Guinea. The streams HH (100 sps), BH (20 sps), and LH (1 sps) of the vertical component (Z) are shown, respectively, to better show the dominant frequency content of each earthquake. Bottom left: Noise-level analysis of MSDA and WDD (the current permanent station). Seismic spectral analysis for the month of March based on the calculation of Power Spectral Density (PSD) distribution using a Probability Density Function (PDF) (McNamara and Boaz, 2006). Grey curves: low noise model (LNM) and high noise model (HNM) (Peterson, 1993). Blue and red curves: maximum and minimum PSD for the data, respectively. Black curve: the highest probability mode. Note: MSDA data is from the temporary deployment and not from the final setting inside the vault. Bottom right: The external and internal view of the vault to house station MSDA.

Real-time monitoring

The SMRU is running SeisComP3 software, configured to acquire seismic data in real time from various networks such as MN, IV, TT, GE, G. The station coverage is distributed to reflect seismically active areas that pose a greater hazard to the Maltese islands, such as the eastern coast of Sicily (Fig. 2) and the Hellenic arc. SeisComP is also used as an earthquake alert system. Earthquakes originating in Greece take at least 2 minutes for the primary wave to reach Malta. With the current configuration SeisComP issues an automatic e-mail and SMS alert within, typically, less than 2 minutes. Following manual verification of an earthquake, and, in the case that the earthquake is of interest to the local authorities, a report is generated and sent to the Civil Protection Department via e-mail.

Figure 2. Screen shot of SeisComP3 graphic user interface showing the location of an earthquake (red circle on map) and the corresponding seismograms (right). Each trace is from a station shown as a coloured diamonds on the map, connected with a fine white line to the epicentre.

References

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