Establishment of an Integrated Italy–Malta Cross–Border System of Civil Protection. Geophysical Aspects
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1. Setting up the Malta Seismic Network: Instrumentation, site selection and real time earthquake monitoring

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1. Introduction

The establishment of an enhanced national seismic network for the Maltese islands, and ultimately for the Sicily Channel region, was carried out within the strategic project SIMIT (*Costituzione di un Sistema Integrato di Protezione Civile Transfrontaliero Italo–Maltese*) funded by the Italia–Malta 2007–2013 Operational Programme. SIMIT was designed to work towards the establishment of an integrated system for the evaluation, forecasting, prevention and mitigation of losses from geological hazards affecting the Sicily Channel. The project was led by the regional Civil Protection Department (CPD) of Sicily and included the Civil Protection Department of Malta and Universities in the region, and therefore one of its important aspects was the raising and dissemination of the awareness about earthquake hazard and risk in this region.

Although the knowledge about seismicity and seismic hazard in Sicily is quite advanced, the same cannot be said about the Maltese islands and other islands in the Sicily Channel. This is a problem that is common to island nations for which the seismicity affecting the countries occurs below the surrounding seas and presents problems in epicentral location, instrumental coverage, near–source effects, etc. Another problem affecting this area is the low–to–moderate level of seismic activity, and the very rare occurrence of large magnitude events in the region, making probabilistic analysis more difficult, and presenting a lack of historical and instrumental data on which to base seismological analyses.

The need was felt to improve the state of seismic monitoring, hazard assessment, and earthquake research in this region. This need was also based on the fact that the active tectonic processes in the Sicily Channel, being in themselves highly interesting from a scientific point of view, are not yet completely understood and have to date been interpreted in contrasting, and sometimes conflicting manners. One step towards this improvement was to increase the number of permanent broadband stations on the Maltese archipelago, which was previously equipped with one station, WDD, belonging to the MedNet network (Boschi and Morelli, 1994). The augmented network would then be integrated with other existing stations in Sicily, Southern Italy and North Africa to establish a modern, real–time network of broadband stations in the Central Mediterranean, based on SeisComP3 protocols, capable of rapid location and analysis of seismic activity, and of fast communication of information to Civil Protection Departments. The seismic network on Malta would have the added advantage of enabling much–improved investigations of geophysical properties and processes on the islands which would contribute to a better knowledge of the seismic response to earthquake shaking, and to seismic risk assessments.

This chapter provides a description of the implementation of these improvements and the preliminary results.

2. Active tectonics and seismicity

Beneath the Sicily Channel lies a relatively stable plateau of the African foreland, the Pelagian Platform that connects Sicily with Tunisia and Libya (Fig. 1). This platform forms a shallow shelf separating the deep Ionian basin from the Western Mediterranean. The local sea–bed topography is characterised mainly by the north–west trending Sicily Channel Rift Zone (SCRZ) — a system that features three grabens of Miocene–Pliocene age (Pantelleria graben, Malta graben and Linosa graben) (Reuther and Eisbacher, 1985). On a regional–scale, the active tectonics of the Central Mediterranean are dominated by the interaction of a number of varied and sometimes poorly understood processes. Superimposed on the convergent scenario of the African plate pushing north–westward, giving rise to the Maghrebides thrust belt, a NE–SW directed extensional regime is presently active in the Sicily Channel. This is expressed in the form of a seismically active east–west trending system of strike–slip lineaments and a series of pull–apart grabens, the SCRZ.

Figure 1 shows well–determined earthquake solutions from various datasets spanning over several years (Dziewonski *et al.*, 1981; Ekstrom

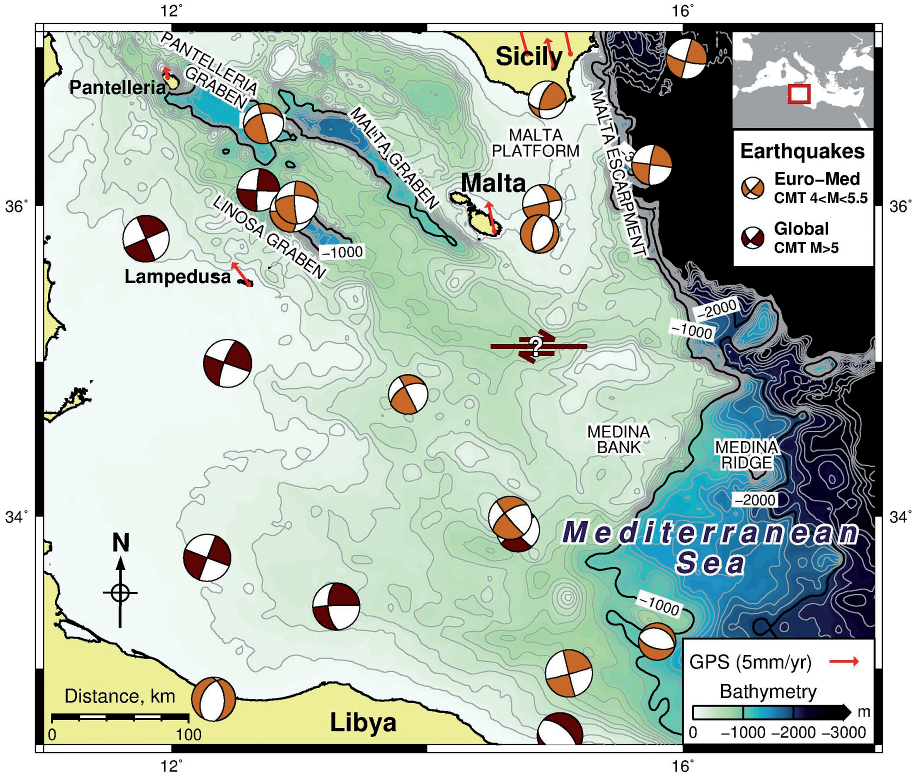

Figure 1. Map showing the system of grabens and the solutions of recent significant earthquakes within the SCRZ. Red and orange beach balls are double couple Centroid Moment Tensor (CMT) solutions from the global catalogue (http://www.globalcmt.org/, Dziewonski *et al.*, 1981; Ekstrom *et al.*, 2012) and from the European–Mediterranean CMT Catalogue (http://www.bo.ingv.it/RCMT/, Pondrelli *et al.*, 2002, 2004, 2007, 2011), respectively. Red arrows are Global Positioning System (GPS) horizontal velocity vectors with respect to fixed Eurasia (Devoti *et al.*, 2011). Note the GPS directional shift between Lampedusa and Malta. The area at approximately 35°N 15°E is seismically active (Fig. 2), however the fault mechanism there is still unknown.

et al., 2012; Pondrelli *et al.*, 2002, 2004, 2007, 2011). This map seems to suggest that very few earthquakes take place within the Sicily Channel, however, the actual seismicity is higher but difficult to quantify precisely due to poor station coverage (e.g., van Eck *et al.*, 2004). Furthermore, data from Global Positioning Systems (GPS) show a directional shift between Lampedusa and Malta (Devoti *et al.*, 2011), strongly indicating that an active extensional process is taking place between the two islands.

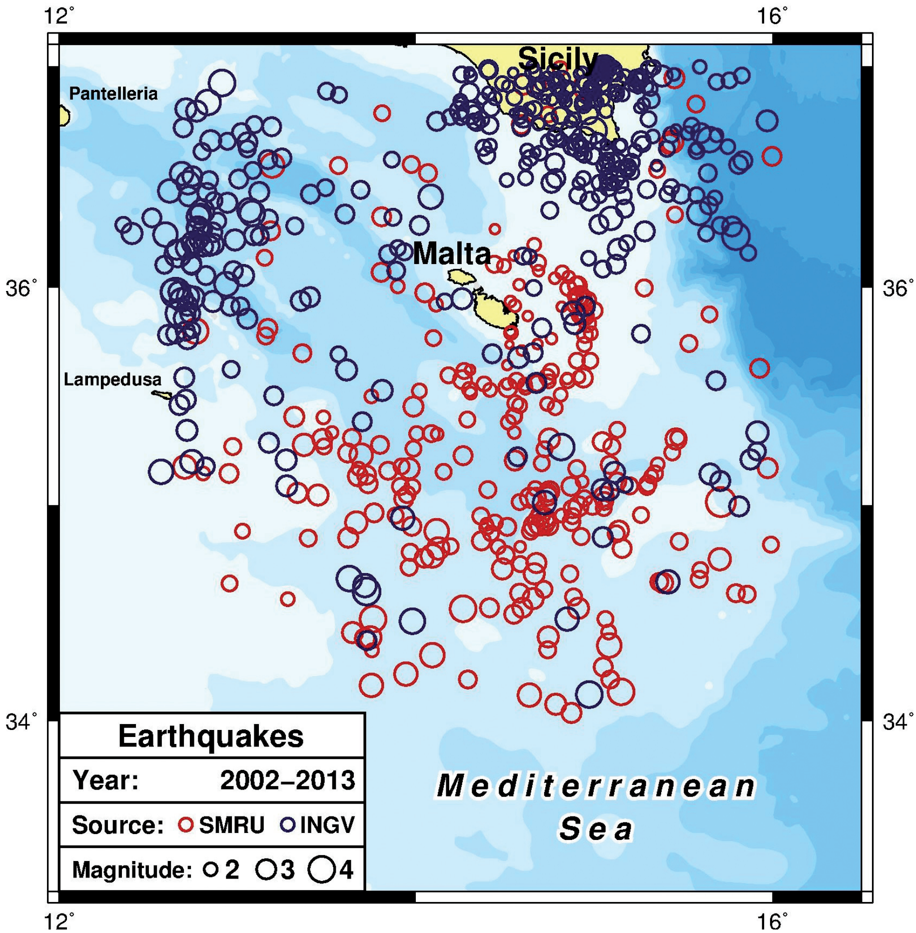

Figure 2. Seismicity map of the Sicily Channel for 2002–2013. Red open circles are earthquake locations determined from single–station analysis using seismic data of WDD (SMRU). Blue open circles are earthquake locations from INGV.

Earthquake monitoring in the Sicily Channel is mainly conducted by the Istituto Nazionale di Geofisica e Vulcanologia (INGV), responsible for the Italian National Seismic Network, and the Seismic Monitoring and Research Unit (SMRU) within the Department of Geoscience at the University of Malta. Figure 2 shows the earthquake epicentre locations as reported by INGV and SMRU for the years 2002–2013. Together the bulletins show a more comprehensive seismicity of the region. The earthquakes broadly match with the sea–bed topographic features, also indicating that the faults are active. Some of the plotted earthquakes have been felt on Malta (e.g., Agius *et al.*, 2015). It is also known that historical earthquakes which generated strong shaking on Malta in the past are likely to be associated with these faults (Galea, 2007).

3. Rationale for the new seismic network

Part of the remit of Work Package 2 within SIMIT was the setting up of an enhanced real–time broadband seismic network in the Central Mediterranean. The aim of this network is to improve the monitoring, reporting and alert of seismic activity in this region, particularly the Sicily Channel which impinges on the cross–boundary area to which the project was dedicated. Until now, this seismic region has always suffered from inadequate station coverage and consequently poorer epicentral location and rapid alert capability, than for example, mainland Italy. Besides its scientific value, the system was to provide timely and accurate reporting of such seismic activity to the Civil Protection Departments of Sicily and Malta. In particular the CPD of Malta was lacking such a direct system of communication with the seismological community. Another advantage of such a network was to improve the earthquake location and analysis for events in the Central Mediterranean. Better knowledge of this seismic activity will help to identify and understand tectonically active structures in the region and thus contribute to a better evaluation of the seismic hazard for Malta, Sicily, and the communities living on smaller islands in the Channel.

Before the start of SIMIT, the seismic monitoring facilities for this region of the Mediterranean consisted of:

a) the Italian National Seismic Network, maintained by the INGV, Rome, with around 45 stations on Sicily and Calabria;
b) one broadband station (WDD) on Malta, which is part of the Mediterranean Network (MedNet, MN) program (Boschi and Morelli, 1994; Mazza *et al.*, 2008) and managed by the SMRU;
c) the National Seismic Network of Tunisia, of which 3 stations were made publicly available in real–time.

Although real–time data from Tunisia, Sicily and nearby islands Pantelleria and Lampedusa were made publicly available in recent years, the SMRU had no system in place to use this data to obtain rapid earthquake locations. Moreover the earthquakes that occurred in the Sicily Channel, especially to the south of the Maltese islands, were not well covered azimuthally by the INGV network, and many of the earthquakes were too weak to be detected by enough stations to give a reliable epicentral location. Earthquakes detected only at WDD (SMRU) were located by a single–station polarisation analysis technique (LESSLA – Local Earthquake Single–Station Analyser, Agius and Galea, 2011), however this is not a real–time method and is subject to a certain amount of error. Despite LESSLA's limitation, the method is still useful for weak events recorded only on one station.

There was therefore the need to set up a monitoring seismic network that acquired real–time data from a number of well–distributed stations and provided better locations and faster dissemination.

4. The Malta Seismic Network (ML)

A unique seismic network code ML was registered with the international Federation of Digital Seismograph Networks (FDSN) (http://www.fdsn.org). The number of permanent stations on the Maltese islands has been increased to three, covering the archipelago more uniformly and allowing better location resolution for nearby earthquakes. The location of the three stations forming the Malta Seismic Network is shown in Figure 3. The network consists of:

a) station WDD in Wied Dalam, in the south of the main island of Malta;

b) station MSDA at the University of Malta, near the centre of the main island;
c) station UMGC at the University of Malta, Gozo Campus, on the northern island of the archipelago.

The new instruments consist of a Trillium 120 PA broadband sensor and a Centaur digitizer (manufactured by Nanometrics Inc.). The three–component data from the new seismic stations is stored in 2 sampling streams: HH at 100 sps, and BH at 20 sps. The two sampling frequencies are broad enough to record local, regional and teleseismic earthquakes, in line with international practice.

Seismograph WDD consists of a Streckeisen triaxial seismometer (STS–2), a Kinemetrics Episensor accelerometer, and a Quanterra Q4120 data acquisition system. All stations are equipped with a GPS antenna receiver and Internet enabled communication for real–time data transmission via the SeedLink protocol. All data is transmitted and stored at the SMRU server, which in turn is enabled to transmit data to international data centers.

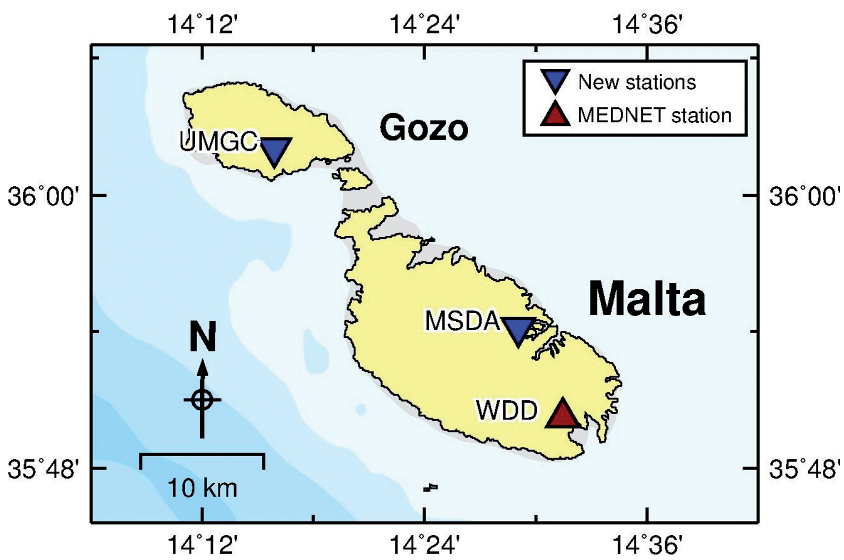

Figure 3. Map showing the location of existing and new seismic stations that make up the Malta Seismic Network (ML).

This network will be augmented by the use of other portable broadband stations that are part of the SMRU list of equipment. Specific, local geophysical studies can be obtained with the combination of the portable stations together with the long–term permanent network. Suitable configurations of the portable stations and permanent network on appropriate geological outcrops will enable earthquake site response and other geophysical studies.

4.1. *Station site selection*

The criteria for the selection of the preferred sites was based on the geographical location, geological setting, and also based on a logistical point of view. Several sites have been considered. At each test site the Horizontal–to–Vertical Spectral Ratio (HVSR) from an ambient seismic noise time series was measured in order to give a first–hand indication of the suitability of the site in terms of the underlying geology. Special attention was required for the Gozo station because this part of the archipelago is characterised by a predominant, thick layer of clay that strongly influences the site response (Vella *et al.*, 2013) causing undesirable peaks in the H/V spectrum. The HVSR curves (Fig. 4) were obtained using Geopsy software (http://www.geopsy.org) by analysing a one hour long segment following the SESAME guidelines (SESAME, 2004). The time series were divided in different time windows of 20 seconds each, without overlap, and for each window the Fourier spectra was calculated and smoothed using a Konno–Ohmachi window (Konno and Ohmachi, 1998).

One of the new stations is sited on Lower Globigerina Limestone at the University of Malta in Msida, located in the centre of the archipelago (35.9012°N, 14.4839°E). This station was given the code MSDA (Fig. 3). The geological setting for this station is ideal because of the "flat" H/V spectrum (Fig. 4) indicating that the station lies on bedrock. The H/V is close to 1 for a broad frequency range up to 10 Hertz, peaking to approximately 1.5 at the lower end of the range. Only ratio peaks exceeding 2 are considered as significantly meaningful, and could indicate underlying shallow impedance contrasts. Here we compare the H/V spectrum with that of station WDD, considered by us as a reference station because it is located on top of Lower Coralline Limestone bedrock — the oldest of the geological formations of the Maltese archipelago (Agius *et al.*, 2014). The H/V ratios of MSDA and WDD are relatively similar to one another, except for some roughness in the spectrum between 1.5 and 4.0 Hz. The seismometer at MSDA is finally laid inside a 1 metre deep vault surrounded with insulation fabric to maintain stable pressure and temperature (Fig. 5).

The other station is located on the northern island Gozo, at the University of Malta Gozo Campus, code named UMGC (36.0341°N, 14.2647°E). Although the site is on Globigerina Limestone, a thick layer of weathered material probably produces the higher H/V ratio for frequencies above 1.0 Hz (Fig. 4). Nonetheless the overall performance of the station, discussed in the next section, is satisfactory. Furthermore the site provides good logistical facilities, and will thus be utilised until a preferred location is available.

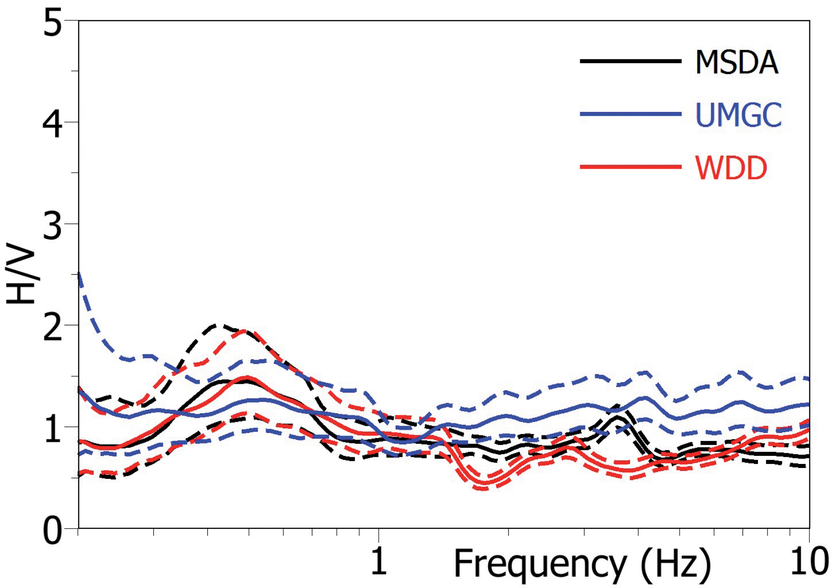

Figure 4. Horizontal to Vertical Spectra Ratio (HVSR) computed for stations WDD, MSDA and UMGC, using ambient seismic noise recordings. Solid line: H/V spectral ratio. Dashed lines: Standard variations. The HVSR curves were obtained using Geopsy software following the SESAME guidelines (SESAME, 2004).

4.2. *Preliminary seismic station performance assessment*

The performance of a seismic station is best established by analysing its spectral content. The various frequency–dependent signals recorded in a seismogram reveal the sensitivity of an instrument to ambient, cultural, and seismic activity. Initially the new stations underwent operational testing at the laboratory. Figure 6 shows two 24–hour seismic traces and their corresponding spectrogram recorded on Sunday 8th and Tuesday 10th of June 2014, on each station. No earthquake was recorded on both dates, and hence, the data primarily contains ambient seismic noise — vibrations generated from cultural activity such as nearby passing cars and also from natural forces such as sea swell. Note that the spectral energy of all the four traces shown in Figure 6 have a constant, high–energy frequency (7.5–8.5 Hz) that has a varying amplitude; high during daytime and low during night time. Additional frequency content is noticeable when comparing the spectrograms recorded on a weekday with that recorded on Sunday. The increased noise in the first half of the day is a result of the bustling student activity in the adjacent room next door. Both stations, which were placed next

Figure 5. The external and internal view of the vault housing station MSDA.

to each other during testing, show similar graphs to one another, as expected.

The long–term performance of a seismic station is better assessed by analysing the continuous traces recorded for a longer period of time. Here we use the standard software package of McNamara and Boaz (2006) to analyse the overall noise levels of the new stations, this time operating at the chosen sites. The algorithm calculates the Power Spectral Density and Probability Density Functions (PSDPDF) using 30–minute long segments of data. Figure 7 shows the power spectral density of 4 weeks of seismic data recorded during the month of June 2015. The PSDPDF analysis show that the stations have the highest probability mode within the low and high international standard of seismic noise models Peterson (1993) for a broad range of frequen-

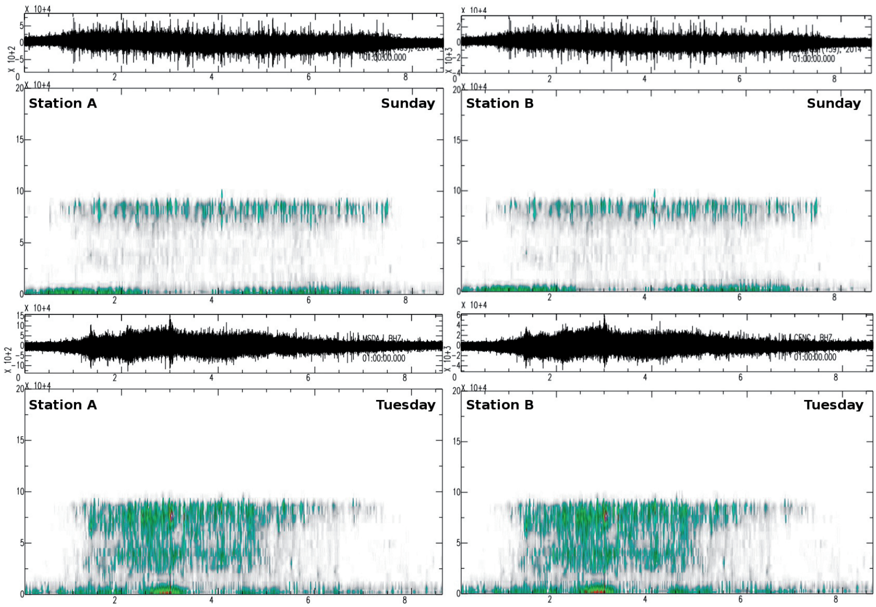

Figure 6. Seismic spectral variations throughout the day recorded on the new stations inside the laboratory. 24–hour seismic trace (top frame) and the corresponding spectral energy (0–20 Hz, bottom frame) of both stations (A and B, left and right column, respectively) recorded on Sunday 8th and Tuesday 10th of June 2014 (upper and lower frame, respectively). The data is the BHZ component (20 samples per second) for all plots. Green and red shade indicate high energy frequencies.

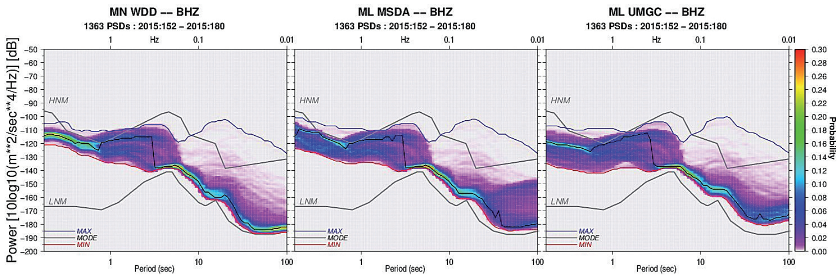

Figure 7. Noise–level analysis of the new seismic stations MSDA and UMGC in comparison with the current permanent station WDD. PSDPDF analysis (McNamara and Boaz, 2006) show that the stations have the highest probability mode (black curve) within the low and high noise models (LNM, HNM, grey curves, Peterson (1993)). Note: The data used for the test stations is from the time when the instruments were laid at the surface and not inside the vault.

cies. The analysis indicates that the stations are performing well. The quality of the data is expected to improve once the stations are laid permanently inside the vault.

4.3. *Earthquake recordings*

In this section we show examples of three types of earthquakes recorded on MSDA and UMGC that are also typical recordings at the other seismic stations located in the Sicily Channel. A local earthquake has its dominant wave energy at higher frequencies, hence such a near distance earthquake is better recorded and analysed at high sample rates (HH, Fig. 8). A regional earthquake that originates from a longer epicentral distance, such as along the Hellenic arc, is sufficiently recorded using a lower sample rate of 20 sps (BH), whereas a teleseismic earthquake is better analysed at low sample rates such as 1 sps (LH). The LH stream is not recorded by the digitizer but is down sampled from the higher streams.

Despite the different locations of MSDA and UMGC the recording of the teleseismic earthquake at each station is "identical". This is because at low frequency the seismic waves sample large scale features of the Earth. In the case of the local earthquake recording, however, differences in the traces are more noticeable: P and S phase arrival time, S–P time difference, waveform, and amplitude.

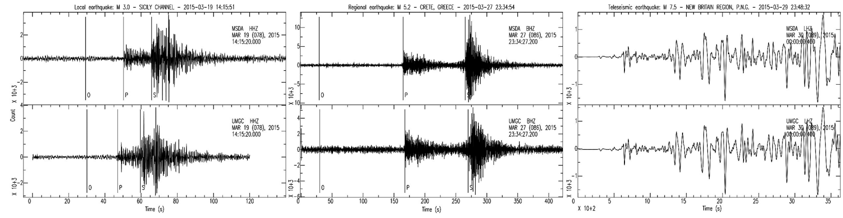

Figure 8. Examples of earthquakes recorded on MSDA and UMGC that are typically registered at other nearby stations in the Central Mediterranean. Local ($\leq$ 100 km): Sicily Channel; regional ($\leq$ 1000 km): Crete, Greece; and, teleseismic ($\geq$ 1000 km): Papua New Guinea. The streams HH (100 sps), 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.

5. Real–time earthquake monitoring

Conforming with the emphasis the new seismic network has within the context of the SIMIT project, robust IT systems capable to handle a crisis as a result of a major earthquake are needed. If possible, the earthquake monitoring system has to be able to run independently and/or have alternatives to critical utilities such as electric power, computer processing, and real–time seismic data streaming. Nowadays several IT solutions and practices, aimed to prevent a complete system failure and also ease recovery if needed, are available and standardized. The expertise and infrastructure of the University of Malta IT Services was entrusted to run the IT system needed for the seismic network.

5.1. *IT infrastructure*

The central IT system of the SMRU, responsible for the streaming and processing of the real–time seismic data and web services, is run on a Linux virtual machine. The machine, in turn, runs on a cloud computing architecture. One of the advantages of using a combination of virtual machines and cloud computing is that the system is hardware independent, hence reducing the risks of failure. Moreover the system and the data are easily backed up and restored. To ensure a robust, continual operation, the IT facilities include a backup electric generator. In case of a major failure at the main site, the complete IT system runs in parallel with another cloned system that is at an off–site location. From a network administrator point of view, with the outsource of such a sophisticated infrastructure, one need not worry unnecessarily about computer hardware issues but focus only on the software running the network.

In general, the software installed is open source: Ubuntu operating system, SeisComP3 for the seismic acquisition and processing, MySQL for the event database, Apache for running the website, and other programmes such as Generic Mapping Tools (GMT) and Seismic Analysis Code (SAC)) for data processing, analysis and visualisation. Users connect to the system using a Secure Shell (SSH) connection. Figure 9 shows a summary of the software set up and interaction between the different modules. Data from seismic stations of the local and international networks are streamed to SeisComP via SeedLink. All the incoming data is stored in a temporary data server, whereas the local data is stored in a permanent storage.

5.2. *SeisComP*

SeisComP is a popular, state–of–the–art, real–time earthquake monitoring software developed by Gempa GmbH (http://www.gempa.de). It has automatic event detection, location, and magnitude determination capabilities. It offers a comprehensive graphical user interface (GUI) for visualisation, rapid event review and quality control (Hanka *et al.*, 2010). Figure 10 shows two different GUI's of SeisComP3, earthquake origin locator view and phase picker window. The former shows the earthquake location and the stations used to estimate the solution. Various tabs (Magnitude, Event, Distance, Azimuth, Travel Time, Move Out, Polar, First Motion) provide the analyst with different ways to view the data. Outlier data (due to one or more several reasons such as a wrong phase pick, inappropriate reference Earth model, bad GPS timing, local heterogeneity, etc.) can be removed from the solution. From the Picker window (Fig. 10) the analyst can view the automated and theoretical P- and S–phase picks. The analyst can: zoom in to the data, apply predefined filters, re pick the phases, and also indicate if the P arrival is positive or negative for a better relocation. The earthquake shown in Figure 10 is an example of a local earthquake that took place about 150 kilometres west of Malta on the 26^{th} of June 2015 and had a magnitude of 4.2.

The local stations are configured to be part of a large 'virtual' seismic network combining numerous stations from various public networks: GEOSCOPE (G), GEOFON (GE), Hellenic Broadband Seismic Network (HL), Italian National Seismic Network (IV), Malta Seismic Network (ML), Mediterranean Very Broadband Seismographic Network (MN), and from the Seismic Network of Tunisia (TT) (Fig. 9). The incorporation of regional stations from across the Mediterranean in this network enables SeisComP to detect immediately distant earthquakes such as those occurring in Italy or Greece, and have appro-

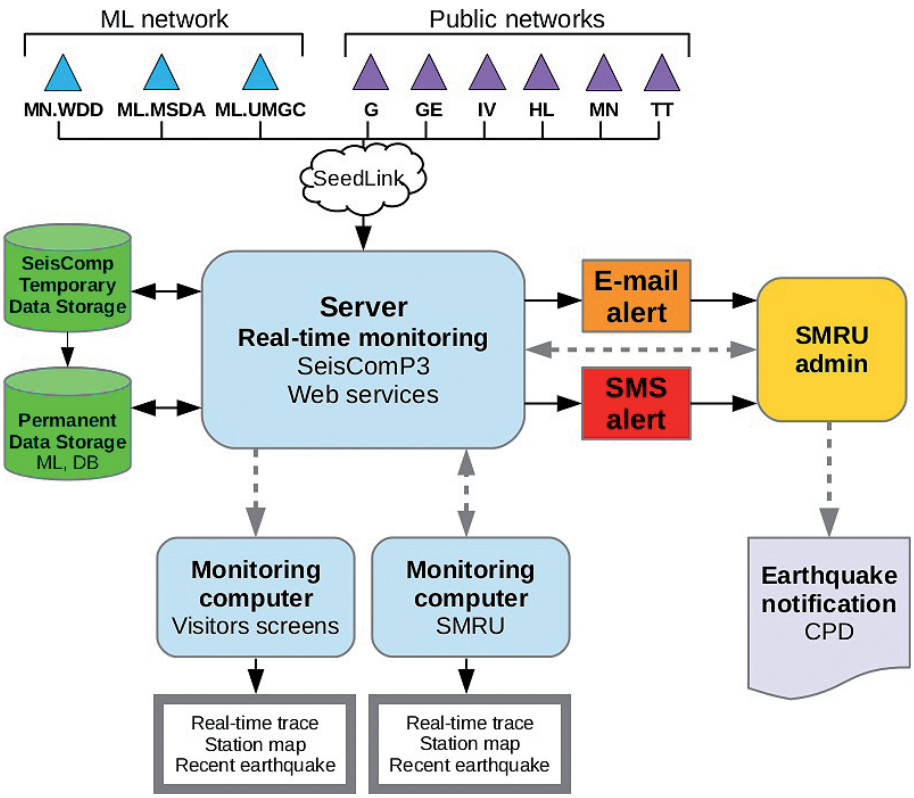

Figure 9. The SMRU IT system infrastructure and communication channels for real–time earthquake monitoring. Triangles: Seismic stations and networks. Cloud: The SeedLink communication protocol via the internet (TCP/IP) between server and stations. Blue rounded rectangles: Real and virtual machines. Green cylinders: Data storage. Open rectangle: Display screens. Red and orange squares: SMS and e–mail alerts sent to SMRU personnel.

priate warnings sent before strong seismic waves reach Malta. The amalgamation of global stations into one network is encouraged in order to aid the system locate better teleseismic earthquakes that can easily be mistaken as strong, deep, local/regional events — risking of issuing false alarms.

5.3. *Earthquake alerts and early warning*

SeisComP is set to issue e–mail notifications immediately whenever it determines a new earthquake or when it makes an update on a previous earthquake. Technical e–mail alerts of all detected earthquakes are sent to the European–Mediterranean Seismological Centre (EMSC). These e–mails include information about phase arrivals from different stations and automatic earthquake location and magnitude estimates. EMSC uses this and other information received from different networks to establish a reliable earthquake location. E-mail and mobile phone Short Message Service (SMS) notifications are sent to SMRU personnel only for earthquakes that have a magnitude 7 or greater anywhere in the world, or when an earthquake can be potentially felt on Malta. A basic criterion based on a magnitude–distance threshold with respect to local past felt earthquakes is used. Automatic earthquake information is published online (http://seismic.research.um.edu.mt) for public reporting, however, this information is clearly marked as *automatic* and that it has not been manually verified.

The system is capable of providing an earthquake early warning, however its implementation depends on how close are the seismic stations to the earthquake source and how far are the concerned population away from the epicentre. For example, in the case of an earthquake that occurs over a thousand kilometers away from Malta (e.g., Greece), and where plenty of seismic stations are also available, SeisComP will issue an alert within 2 minutes — well within the time it takes for potentially dangerous seismic surface waves to propagate through the Sicily Channel (estimated to traverse through it after approximately 4 minutes). On the other hand, if an earthquake occurs close to Malta, within the Sicily Channel, an early warning alert for the region will be ineffective because the seismic waves will arrive 'instantly'. Even though one can install new instruments closer to the earthquake sources, which in the case of the Sicily Channel would require ocean bottom seismometers, not much can be done with today's technology to counteract this problem known as the "blind zone".

5.4. *Civil Protection Department*

Despite SeisComP's success at locating earthquakes one still has to be aware of possible wrong locations, at least at the initial stage of the automatic location until more seismic data reaching farther stations is processed. Hence, earthquake alerts are restricted to SMRU personnel for manual verification. If the earthquake is of importance to the CPD, a brief semi–automated report is generated online and is manually sent to the authorities via e–mail. Figure 11 is an example of an earthquake report sent to the CPD for the 26th of June 2015 earthquake (Fig. 10). Such reports are aimed to give general information on the earthquake location and magnitude, as well as other comments that the analyst deem important such as in this case that no felt reports have been submitted to SMRU.

6. Conclusions

A new permanent seismic network consisting of 3 broadband stations is currently being deployed across the archipelago of Malta. The Malta Seismic Network has a registered network code "ML". The new stations will contribute to locate better the local seismicity, which until recently was only recorded on one station. The station azimuthal coverage within the Sicily Channel will improve significantly, in particular within the islands of Pantelleria, Lampedusa and Malta, enabling seismologists determine better earthquake solutions in the region.

The SMRU now has a real–time earthquake monitoring facility capable of detecting light–to–moderate earthquakes, or stronger, that occur within the Mediterranean. All earthquake notifications are sent to EMSC via e–mail, whereas in the case of an "important" earthquake SMS and e–mail alerts are sent to SMRU personnel only. A new chain of communication for earthquake reporting is now established between the SMRU and the CPD of Malta. The monitoring system serves as a platform that can lay the foundations for an early warning system for Malta, for potentially dangerous earthquakes that occur in Greece or Italy, as well as contributing to the Tsunami Early Warning System for the Mediterranean.

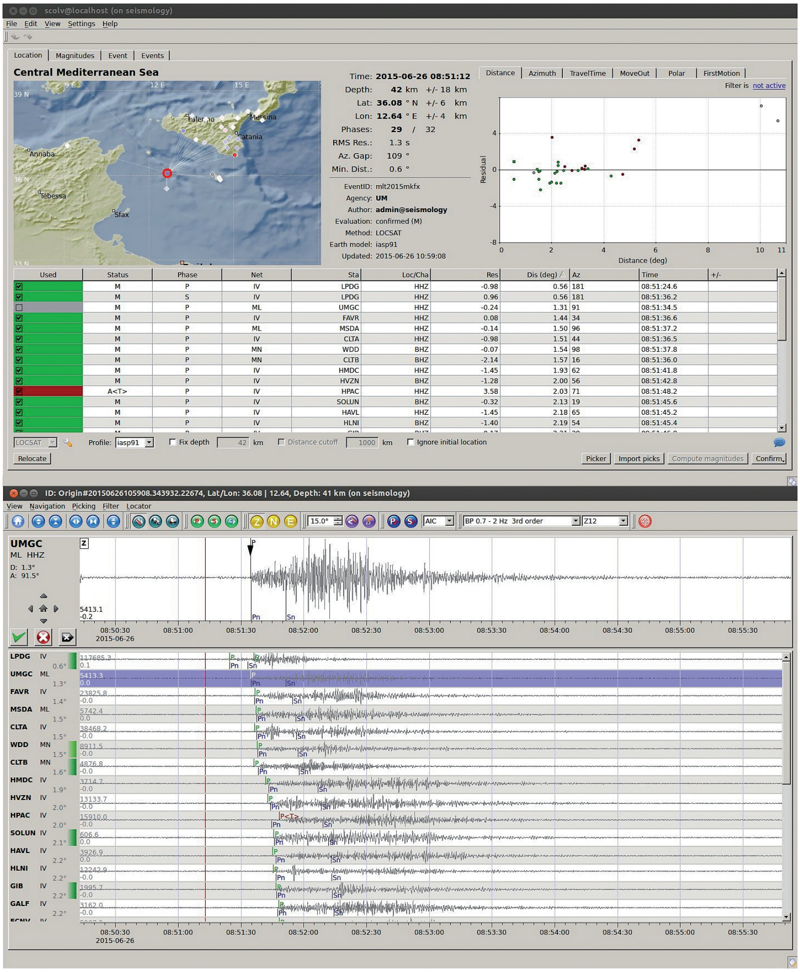

Figure 10. SeisComP3 earthquake origin locator view and phase picker window. Example of a relocated local earthquake that occurred on the 26th of June 2015. Top: SeisComP origin locator view (scolv) mapping the earthquake location and the stations used to estimate the solution. Various tabs provide the analyst with information that could help with the manual reprocessing of the event. Bottom: Phase–picking window showing the seismograms and the theoretical P and S–phase arrivals. The analyst can zoom in the data and apply predefined filters in order to help facilitate manual re picking of the phases.

The broadband stations on the Maltese archipelago, together with other portable instruments, will also provide the possibility of investigating seismic site response effects due to varying geology, as well as other geophysical studies, therefore contributing to better seismic risk analysis for the country.

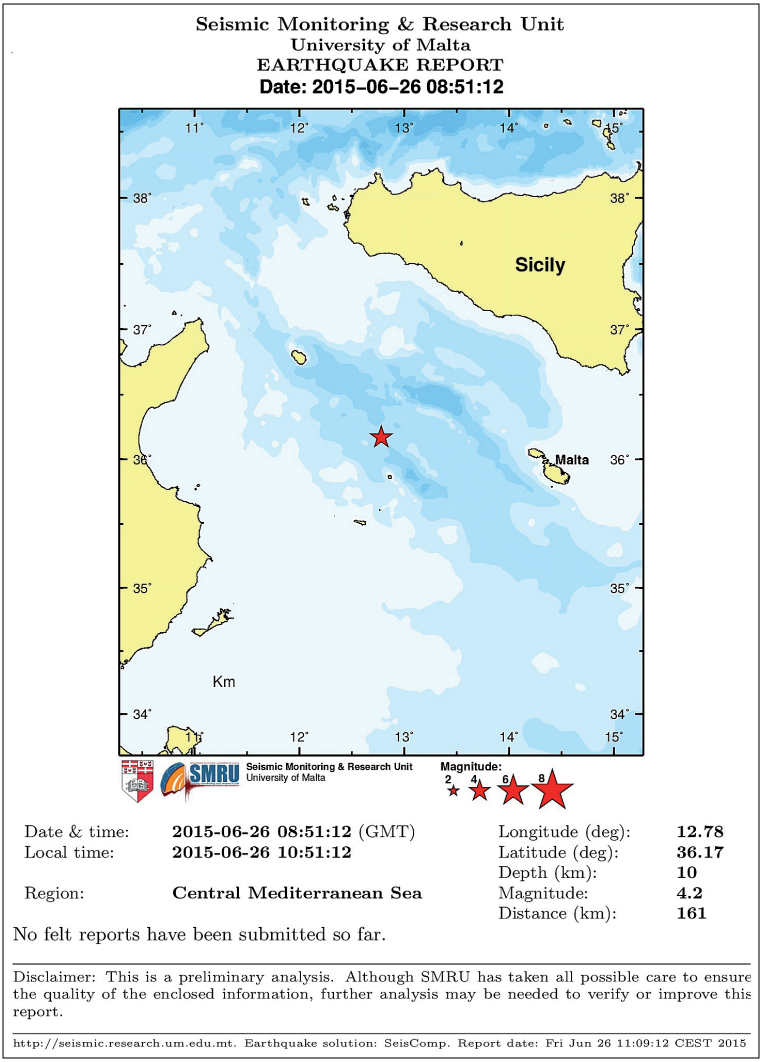

Figure 11. An earthquake report issued by the SMRU to the CPD for a local earthquake that occurred on the 26th of June 2015.

7. Acknowledgements

Some figures were created using the Generic Mapping Tools (Wessel and Smith, 1998) and the Seismic Analysis Code (Goldstein and Minner, 1996; Goldstein et a1., 1998). This study was supported by SIMIT Project part–financed by the European Union, European Regional Development Fund (ERDF) under the Italia–Malta Cross–Border Cooperation Programme, 2007–2013.

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