TSUNAMI RISK ASSESMENT AND POSITIONING OF A TSUNAMI EARLY WARNING SYSTEM

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TSUNAMI RISK ASSESMENT AND POSITIONING OF A TSUNAMI EARLY WARNING SYSTEM

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ABSTRACT

TSUNAMI RISK ASSESMENT AND POSITIONING OF A TSUNAMI EARLY WARNING SYSTEM

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Tsunamis are rarely experienced events; they have enormous potential to cause large economic destruction on the critical infrastructures and facilities, social devastation due to mass casualty, and environmental adverse effects like erosion, accumulation and inundation. Especially for the past two decades, nations have encountered devastating tsunami events. The aim of this study is to investigate economic, social and environmental risks along the coastline for Eastern Mediterranean due to tsunamis. Additionally, the best position for a Tsunami Early Warning System (TEWS) among a set of potential locations in the Eastern Mediterranean based on the maximum social risk reduction is identified. In achieving these goals, the following analysis are sequentially conducted: i) Probabilistic tsunami modelling, ii) Social, economic, and environmental risk assessment and iii) Decision making for the best location of TEWS. Probabilistic tsunami modelling is carried out through Monte Carlo Simulations. NAMI-DANCE is used to simulate tsunamis originating in the selected area. Social, economic and environmental risks are calculated for selected 91 elements at risk located in Cyprus, Egypt, Greece, Israel, Lebanon, Syria and Turkey. Depth-damage curves and exceedance probabilities are used to calculate social and economic risks while environmental risk is calculated using a binary approach. Overall risk maps are also constructed for three different scenarios using ArcGIS environment for the whole study area. The highest risk is calculated for Cairo Agricultural Area with respect to economic and social risk dimensions. In Turkey, Fethiye City Center is identified as the most critical element at risk for economic risk assessment. A number of potential locations for TEWS are determined based on physical constraints identified through an extended literature review and corresponding social risk reductions for each of these TEWS calculated. The best location for the TEWS is identified around 35.45°N/28.21°E.

Keywords: Tsunami modelling, Risk assessment, TEWS positioning, NAMI-DANCE, ArcGIS

ÖZ

TSUNAMİ RİSK DEĞERLENDİRMESİ VE TSUNAMİ ERKEN UYARI SİSTEMİ İÇİN UYGUN YERİN BELİRLENMESİ

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Tsunami nadiren görülen doğal afetlerden olmasına rağmen kritik altyapı ve üstyapılar üzerinde çok büyük economik yıkıma, çok sayıda insanın hayatını kaybetmesine ve erozyon, birikim ve su baskınları gibi olumsuz çevresel etkilere neden olmaktadır. Özellikle son yirmi yılda uluslar bir çok yıkıcı tsunami olaylarına maruz kalmışlardır. Bu çalışmanın amacı, Doğu Akdeniz sahilleri boyunca olası tsunamilerden kaynaklanan riskleri ekonomik, sosyal ve çevresel risk boyutlarını dikkate alarak incelemektir. Ayrıca, Doğu Akdeniz'deki sosyal riskin maksimum seviyede azaltılmasını sağlayacak tsunami erken uyarı sistemi için bir dizi potansiyel lokasyon arasından en iyi yerleştirme noktasını belirlemektir. Bu hedeflere ulaşabilmek için aşağıdaki analizler sırasıyla yürütülmüştür: i) Olasılıksal tsunami modellemesi, ii) Sosyal, ekonomik ve çevresel risk değerlendirmesi ve iii) Tsunami erken uyarı sisteminin en iyi yerinin belirlenmesi. Olasılıksal tsunami modellemesi Monte Carlo Simulasyonları ile gerçekleştirilmiş ve seçilen bölgede oluşan tsunamiler NAMI-DANCE programı kullanılarak simüle edilmiştir. Kıyı şeridi boyunca Kıbrıs, Mısır, Yunanistan, İsrail, Lübnan, Suriye ve Türkiye'den belirlenen 91 risk altındaki unsur için sosyal, ekonomik ve çevresel riskler hesaplanmıştır. Sosyal ve ekonomik riskleri hesaplamak için derinlik-hasar eğrileri ile aşılma olasılıkları kullanılırken, çevresel risk hesabı için ikili bir yaklaşım kullanılmıştır. ArcGIS programı kullanılarak ekonomik, sosyal ve çevresel riskler üç farklı senaryo için entegre edilerek genel risk haritaları oluşturulmuştur. En yüksek risk, ekonomik ve sosyal risk boyutlarına göre Kahire Tarımsal Alanı için hesaplanmaktadır. Türkiye'de ise ekonomik risk boyutuna göre en önemli risk unsuru olarak Fethiye Şehir Merkezi belirlenmiştir. Tsunami erken uyarı şamandıraları için birtakım potansiyel konumlar, fiziksel kısıtlamalara göre belirlenmiş ve bu erken uyarı şamandıralarının her biri için karşılık gelen sosyal risk azaltma yüzdeleri hesaplanmıştır. En iyi şamandıra lokasyonu yaklaşık 35.45 ° K / 28.21 ° D olarak belirlenmiştir.

Anahtar kelimler: Tsunami modellemesi, Risk değerlendirmesi, Tsunami erken uyarı sistemi yerleştirilmesi, NAMI-DANCE, ArcGIS

To my precious family

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1 INTRODUCTION

The term "Tsunami" is generated after The Great Meiji Sanriku Tsunami happened on June 15, 1896 at the coast of Tohoku region. This terminology consists of two Japanese words "Tsu" and "nami" meaning harbor and wave, respectively (Nakao, M. 2001).

All earthquakes do not cause tsunamis. The most important criterion for the formation of tsunami is the sudden change in the sea floor. Landslides, volcanic eruptions, glacier carvings, meteorite impacts and mostly undersea earthquakes can be potential hazards to trigger a tsunami. Most of the destructive tsunamis are generated at subduction zones. Collision regions of tectonic plates create high seismicity, which resulted in devastating shallow earthquakes with an epicenter or fault close to the ocean floor. When tectonic plates move towards each other, they displace large areas of the ocean floor reaching up to thousands of kilometers (ITIC, 2017). If an earthquake occurs under the sea, it creates a displacement and from this source, huge amount of energy is transferred to the water column over the displaced area. This enormous amount of energy causes a sea level rise and generates a tsunami. This displacement causes an abrupt increase on the sea level at the surface and spread out from the source in all directions. In deep water, the height of the wave can be expressed with centimeters and the celerity of the wave can be defined as a function of gravitational acceleration and the depth of the water column (i.e. $V = \sqrt{gh}$). However, as the wave reaches shallower zone near the shore the wavelength becomes shorter and the height of the wave increases. Because of this phenomenon, tsunami waves create an enormous risk especially along the shoreline. Tsunami waves can move for many kilometers inland and devastate all living things in its path. Historical tsunami events show that densely populated areas along the coastline and coastal structures as harbors, marinas, aquaculture areas have been mostly affected by tsunamis.

Though tsunamis are rarely experienced events, they have enormous potential to cause large economic destruction on the critical infrastructures and facilities, social devastation due to mass casualty, and environmental adverse effects like erosion, accumulation and inundation. Especially for the past two decades, nations have encountered devastating tsunami events. In 2004, Indian Ocean Earthquake and Tsunami hit the west coast of Sumatra with the magnitude of M_w9.1-M_w9.3 and resulted in approximately 250000 casualties, 700000 homeless, and more than $4.4 billion economic destruction (Ozel et al. 2011). As explained in World Health Organization (WHO, 2012), Tohoku earthquake and tsunami occurred off the coast of Japan with magnitude M_w9.0-M_w9.1 and triggered a mega tsunami for which the measured height of the wave reached up to 38 m. In Arahama region of Sendai city, tsunami waves travelled up to 5 km inland. The results of the earthquake and tsunami were also devastating. It led 15848 officially recorded death toll, approximately 300000 homeless and $122 billion economic lost due to destruction of properties and critical infrastructures like Fukushima Daiichi Nuclear Power Plant. Failure of the nuclear power plant caused severe long-term environmental and health hazard which cannot be estimated completely within several years (World Health Organization, 2012). Assessing risks of such disasters is necessary and provides crucial information for developing necessary precautions and management strategies.

The Eastern Mediterranean Sea is 3900 km long and its maximum width is 1600 km and greatest depth is 4400 m. It is one of the biggest marginal seas on the planet. Although Mediterranean Sea is a closed basin, extreme storms and storm surges, tsunami, freak waves and waterspout have been observed periodically. During the last 36 centuries, 67 earthquakes with the magnitude of greater than 7 (M_w>7), 133 earthquakes with the magnitude between 6 and 7 (7>M_w>6) and at least 96 tsunamis were documented in the Eastern Mediterranean (Altınok and Ersoy 2000). Thus, Eastern Mediterranean is selected as the case study area.

The utilization of the coastal area of Eastern Mediterranean has increased in the recent years with projects such as large commercial ports, international airports, oil and gas pipelines and recreational infrastructures both Turkish and the countries having the shorelines in Eastern Mediterranean (Papadopoulos et al., 2010).

The novelty of this thesis is listed as follows;

- Monte Carlo (MC) simulations are used to conduct probabilistic tsunami modelling for multicriteria risk analysis along the Eastern Mediterranean coastline.
- A large area that includes 91 Elements at Risk (EaR), i.e. city centers, summer villages, industrial areas, agricultural lands, and environmentally critical infrastructures from Cyprus, Egypt, Greece, Israel, Lebanon, Syria, and Turkey is selected as the study area.
- Tsunami simulations are performed using NAMI-DANCE software to analyze and compute generation, amplification and propagation of tsunami waves to estimate the inundated area of each EaR in the study area.
- Economic, social and environmental risk dimensions are calculated for all EaR in this study. Moreover, three different aggregation approaches are used to estimate the overall risk for each EaR in the study area.
- A new tsunami awareness index is proposed in this study based on a comprehensive literature review and expert knowledge.
- Best Tsunami Early Warning System (TEWS) locations among a selected set is identified based on social risk reduction.

Based on risk assessment results, Cairo Agricultural Area resulted in the highest economic, social and overall risk. For Turkey, Fethiye is identified as the most critical element at risk for economic risk assessment.

Additionally, six potential TEWS locations are selected in the study area. The only way to survive from tsunami waves is assumed to reach the safe altitude on foot. Required time to reach the safe altitude and remaining time to reach the safe altitude after tsunami warning are calculated for each EaR. Then, the number of physically damaged people is calculated for both with and without TEWS. The results show that the TEWS positioned at 35.45°N/28.21°E provides the maximum social risk reduction in the Eastern Mediterranean.

In Chapter 2, a comprehensive literature survey is conducted about earthquake source parameters and historical earthquake catalogues, probabilistic analysis of historical earthquakes with Monte Carlo simulation method, tsunami simulation means and data processing, risk assessment studies, tsunami early warning buoy deployment and tsunami awareness. The methodology used in this study is given in Chapter 3. Methodology chapter includes the definition of the study area, generation of earthquake source parameters and probabilistic tsunami simulations conducted by MC simulations, calculation methods of economic, social and environmental risk dimensions and the method used for positioning of TEWS with respect to social risk reduction. Results of the study and related discussions are given in Chapter 4. Finally, concluding remarks, major findings and suggestions for future researches and investigations are pointed out in Chapter 5.

2 LITERATURE REVIEW

The goal of this study is to carry out a risk assessment study for tsunamis that may originate in the Eastern Mediterranean Sea. Literature review related with earthquakes causing tsunamis, tsunami waves, their propagation and modeling, risk assessment and tsunami early warning systems are provided in this chapter.

2.1 Definition of the Faults and Earthquake Source Parameters

Faults are defined as the breaks on the earth surface across which there is visible displacement as shown in Figure 2.1 (Web 2.1). Some of the faults break the Earth's surface some of them do not. If the fault breaks the Earth's surface during the last 10000 years, it is called an active fault. The latter fault is called as a blind fault (Twiss and Moores, 2007).

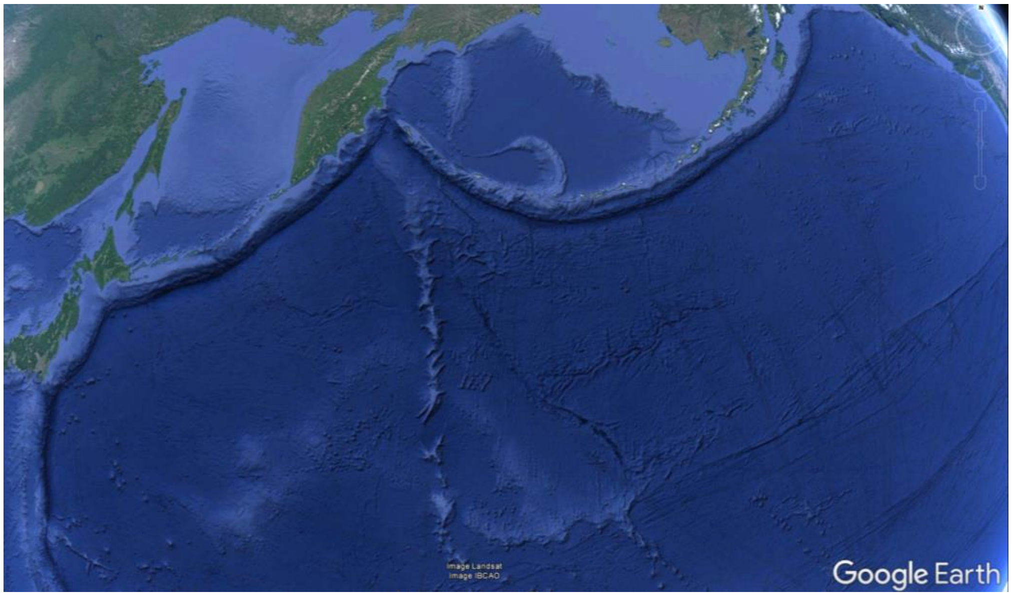


Figure 2.1 Part of the Pacific Ring of Fire, (Web 2.1)

The United States Geological Survey Institute, (USGS) (WEB 2.2) compiled definition of the faults and source parameters in an earthquake glossary. NAMI-DANCE software is used in this thesis. The source parameters used as inputs of NAMI-DANCE are explained using USGS's earthquake glossary in Table 2.1.

Table 2.1 Definition of the source parameters used in this thesis (Web 2.2)

Property	Description	Nami-Dance Source Input	Fault Dependency	Changing from earthquake to earthquake
Bathymetry	Selected region for earthquake generation and tsunami simulations	YES	NO	NO
Grid size	Depending on the bathymetry	YES	NO	NO
Richter Magnitude (M_w)	Function of Seismic moment	YES	NO	YES
Focal Depth	The focal depth refers to the depth of an earthquake hypocenter. The hypocenter is the point within the earth where an earthquake rupture starts. The epicenter is the point directly above it at the surface of the Earth. Also commonly termed the focus. The epicenter is the point on the earth's surface vertically above the hypocenter (or focus), point in the crust where a seismic rupture begins.	YES	NO	YES
Longitude **Latitude**	Location of the rupture area	YES YES	YES YES	YES YES
Strike Angle	The strike is the trend or bearing, relative to north, of the line defined by the intersection of a planar geologic surface (for example, a fault or a bed) and a horizontal surface such as the ground.	YES	YES	Depending on the location along the fault
Dip Angle	Dip is the angle that a planar geologic surface (for example, a fault) is inclined from the horizontal.	YES	YES	NO
Rake Angle	Rake is the direction a hanging wall block moves during rupture, as measured on the plane of the fault. It is measured relative to fault strike, ±180°.	YES	YES	Depending on the type of the fault
Displacement	Displacement is the difference between the initial position of a reference point and any later position. The amount any point affected by an earthquake has moved from where it was before the earthquake.	YES	YES	Depending on the magnitude of the fault
Seismic Moment (M_0)	Function of fault length, fault width, shear modulus and displacement	NO	YES	YES
Fault Length (L)		YES	YES	YES
Fault Width (W)		YES	YES	YES

In this study, Monte Carlo (MC) simulations are used to calculate the risk. In each MC simulation, a random earthquake is generated. The random earthquake is defined by the earthquake source parameters listed in Table 2.1. MC simulations can only be applied for independent parameters (Robert et al. 2010; Rubinstein and Kroese, 2016). As can be seen in Table 2.1, moment magnitude (M_w) and $Focal\ depth$ are the independent parameters of the fault. Thus, an earthquake from the database that is put together to be used in this study is sampled first and all the source parameters other than M_w and $Focal\ depth$ of this earthquake are used in each MC simulation. M_w and $Focal\ depth$ for the random earthquake is sampled from the probability density functions of these two variables. Fault length and fault width are not given in the earthquake database, thus these two parameters are calculated using empirical equations. Literature survey on the earthquake source parameters is given in the following sections.

2.2 Historical Earthquake Catalogues

In calculating tsunami risks, information on historical earthquakes that caused tsunamis are required. There are a number of earthquake catalogues and databases with such information. However, each source uses a different classification and different set of earthquake source parameters. These databases are examined in detail to identify the most suitable one(s) to be used in this study.

Storchak et al. (2013) compiled a global instrumental earthquake catalogue named as International Seismological Centre – Global Earthquake Model (ISC – GEM). This is one of the wide-ranging global earthquake catalogues prepared for scientists dealing with seismic hazard modelling and risk assessment. This catalogue contains more than 20000 earthquakes observed within 114 years for the period of 1900 – 2013. Storchak et al. (2013) prepared this catalogue in three parts, based on different moment magnitudes, M_w:

- 1900 – 1917 $M_w \geq 7.50$
- 1918 – 1959 $M_w \geq 6.25$
- 1960 – 2009 $M_w \geq 5.50$

ISC-GEM catalogue does not contain all required source parameters such as fault length, fault width, displacement, strike-dip-rake angles etc. Hence, ISC-GEM catalogue is not used into this study.

KOERI is another earthquake catalogue compiled by Bogazici University Kandilli Observatory and Earthquake Research Institute (KOERI) Regional Earthquake-Tsunami Monitoring Center (RETMC) (Web 2.3). The catalog provides earthquake and tsunami forecasts instantaneously in the region. This catalog is the most up-to-date catalog examined for the region. However, most of the earthquake source parameters listed in Table 2.1 are not provided in KOERI's database.

The earthquake catalogue used into this thesis is compiled by EU funded TRANSFER (Tsunami Risk ANd Strategies For the European Region) Project (Web 2.4). The catalogue contains most of the historical source parameters and necessary references used for the generation of the catalogue.

2.3 Earthquake Source Parameters and Their Relations

Estimation of earthquake source parameters is the backbone of the tsunami hazard and risk assessment. In recent years, there are many studies conducted on reliable earthquake parameter estimation to be used in risk reduction and tsunami early warning system analysis for the investigated region (Hoshiba and Ozaki 2014; Melgar et al. 2015; Goda and Abilova 2016).

Hoshiba and Ozaki (2014) stated that for earthquakes with higher moment magnitudes the correct estimation of earthquake information gets more difficult especially during early stage of the earthquake. For instance, Japan Meteorological Agency (MJA) underestimated the magnitude of the 2011 Tohoku earthquake and tsunami as M_w7.9 just 3 minutes after the earthquake and revised M_w8.4 after 74 minutes from the incident. Unfortunately, the correct magnitude of the earthquake (M_w9.0) was able to estimated 134 minutes after the earthquake (Hoshiba and Ozaki, 2014). Although the distance between Japan and the US exceeds 8000 miles, the United States Geological Survey (USGS) achieved to estimate the correct magnitude, M_w9.0 about 20 minutes after the earthquake. Hoshiba and Ozaki, (2014) stated that the correct estimation of the magnitude of earthquake is critical in saving lives and property and to maximizing the reduction of the risk along the coastline from economic and environmental point of view.

Goda and Abilova (2016) conducted a study to investigate underestimation of earthquake source parameters for tsunami risk assessment and contribution of tsunami early warning systems to economic risk reduction. The 2011 Tohoku earthquake was selected as the case study to analyze the economic risk and early warning steps along coastal residential areas. They carried out tsunami hazard estimation for 86000 building from Miyagi Prefecture and compared their findings with those obtained from different tsunami hazard scenarios. The results were evaluated in terms of tsunami risk estimation and management. In order to achieve this goal, Goda and Abilova (2016) conducted a probabilistic tsunami hazard analysis (PTHA) and risk assessment study.

It is observed from the historical earthquake catalogues that some of the parameters of the earthquakes are not recorded in the catalogues. However, earthquake source parameters are vital for generating reliable tsunami simulations in the study area. A comprehensive survey is conducted to determine commonly used empirical equations in earthquake source parameter calculations.

Hanks and Kanamori (1979) developed well accepted and commonly used empirical equations demonstrating the relationship between the shear modulus of the crust, fault length, fault width and seismic moment. However, the equations generated by Hanks and Kanamori (1979) are not enough to calculate all parameters of earthquake source such as fault length, fault width and displacement occurred at the earthquake hypocenter. Some empirical equations showing the regressions between the moment magnitude and earthquake source parameters are proposed by the researchers (Wells and Coppersmith, 1994; Papazachos, 2004; Blaser et al. (2010); Goda et al. 2016). Among these empirical equations, the equations proposed by Wells and Coppersmith (1994) is used to calculate fault length and fault width for the earthquake source parameters in this thesis. Displacement is calculated by using both the equation proposed by Hanks and Kanamori (1979) and the calculated fault length and fault width by the equation proposed by Wells and Coppersmith (1994).

2.4 Probabilistic Analysis of Past Earthquakes with Monte Carlo Simulation Method

Distribution fitting to the independent earthquake source parameters is one of the most important step of random data generation from the observed data. Goodness of fit tests are used to identify the best distribution. Large number of goodness of fit tests have been recommended and performed to identify the most appropriate distribution (D'Agostino and Stephens, 1986). Commonly used goodness of fit tests are (Wilks, 2011):

- The chi-square
- Kolmogorov-Smirnov
- Anderson-Darling
- Shapiro-Wilk

Goodness of the fitted distribution can be measured with its p-value. P-value shows the statistical significance level of the fitted distribution to the data based on the defined confidence interval (α). The smaller p value represents the better fitness level of the assigned distribution (Kul, 2014). In this study, goodness of the fitted distributions for the independent parameters of the earthquake is tested using Kolmogorov-Smirnov test due to its simplicity and practicality.

2.5 Tsunami Simulations

Different numerical models are developed for tsunami simulations since 1960's. Some of the most commonly used Tsunami modelling software are TUNAMI N1 (Imamura, 1995), MOST (Titov, 1997; Soreide et al. 2011), NAMI DANCE (Yalciner et al. 2006) and SIFT (Huang et al. 2017). The common aim of all these software is to analyze and compute generation, propagation and amplification of selected tsunamis depending on the source parameters using seismic source characteristics. All these models have the capability to compute components of tsunamis in shallow waters and the inundation zones in specified region.

In this study, NAMI DANCE (Yalçıner et al. 2006) is used to carry out tsunami simulations. Since NAMI DANCE was developed by the researchers at Middle East

Technical University, it is possible to get quick technical support. This was the main reason for using NAMI-DANCE to conduct tsunami simulations in this study.

2.5.1 NAMI-DANCE

NAMI-DANCE uses the shallow water equations, which are bounded by the sea surface and the bottom topography. Shallow water equations precisely describe the tsunami propagation with long wave assumption (Segur, 2007). The long wave assumption can be described as a wavelength, L_w sufficiently long as compared with the water depth, h_w : L_w>>h_w.

In order to derive the shallow water equations, global conservation of mass should be considered. Continuity equation should be satisfied for all conditions:

$$\frac{\partial \eta}{\partial t} + \frac{\partial [u(h+\eta)]}{\partial x} + \frac{\partial [v(h+\eta)]}{\partial y} = 0 \tag{2.1}$$

where η is the vertical free surface displacement, t is time and u and v are the velocity components in x and y directions and h is the basin depth, respectively.

Assuming that there is no vertical velocity variations and vertical pressure gradients are nearly hydrostatic, the momentum equations and continuity equation of shallow water condition can be written as (Segur, 2007):

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + g\frac{\partial \eta}{\partial x} + \frac{\tau_x}{\rho} = 0 \tag{2.2}$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + g\frac{\partial \eta}{\partial y} + \frac{\tau_y}{\rho} = 0 \qquad (2.3)$$

where τ_x and τ_y are bottom shear stress components and g is the gravitational acceleration. Both of these equations together generate the parts of the shallow water equations in case of no Coriolis, frictional or viscous forces.

2.5.2 Inundation level Calculations

Synolakis (1987) conducted one of the most reliable studies on the calculation of maximum run-up level (in meter) of non-breaking solitary waves on plane beaches (see Figure 2.2).

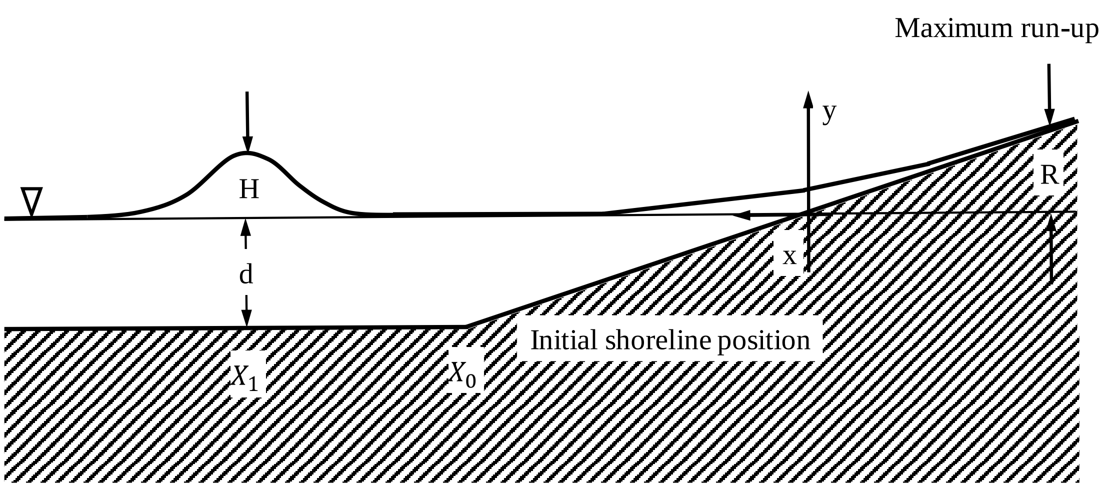


Figure 2.2 Definition sketch for maximum run-up on a plane beach (Synolakis, 1987)

An experimental set up was constructed with the dimensions of 37.73 m x 0.61 m x 0.39 m tank and a plane beach with the slope of 1/19.85. By means of the derivation of shallow water equations and experimental results, an empirical equation was proposed to calculate onshore run-up level (Synolakis, 1987). Synolakis (1991) also worked on Green's law of evaluation of solitary wave on plane beaches. The law revealed a precise solution for linear shallow water wave equations on constant depth and sloping beaches (see Figure 2.3).

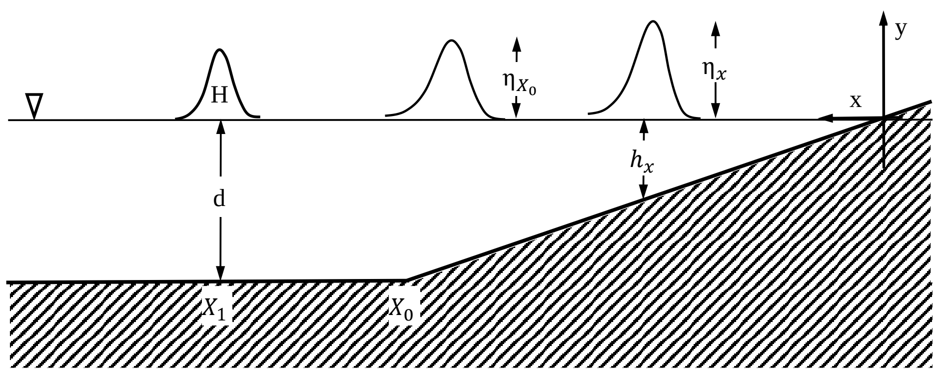


Figure 2.3 Evaluation of solitary wave on plane beaches (Synolakis, 1991)

Kanoglu and Synolakis (1998) conducted a study on long wave run-up calculation considering the contribution of continental shelf and slope on run-up levels. The study is dealing with two plane beaches having different slopes and based on a revised version of the maximum run-up equation proposed by Synolakis, (1987) (see Figure 2.4).

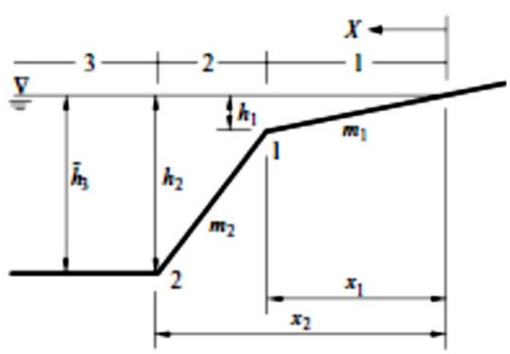


Figure 2.4 Definition sketch for two plane beaches having different slopes (Kanoglu and Synolakis, 1998)

Lovholt et al. (2012) conducted a scenario based tsunami hazard and risk mapping study on the global scale. Tsunamigenic earthquakes which can generate hazardous tsunami waves were taken into consideration in order to model offshore waves and calculate run up levels close to the shoreline (at 0.5 m water depth) using the empirical method named Green's law. A model set up having a flexible numerical implementation was constructed based on the analytical model proposed by Kanoglu and Synolakis (1998). Time series gauges was located at -50 m water depth and the wave amplifications recorded at the gauges were used to calculate run-up level at 0.5 m water depth as a function of fault width with Green's law for non-breaking waves (see Figure 2.5).

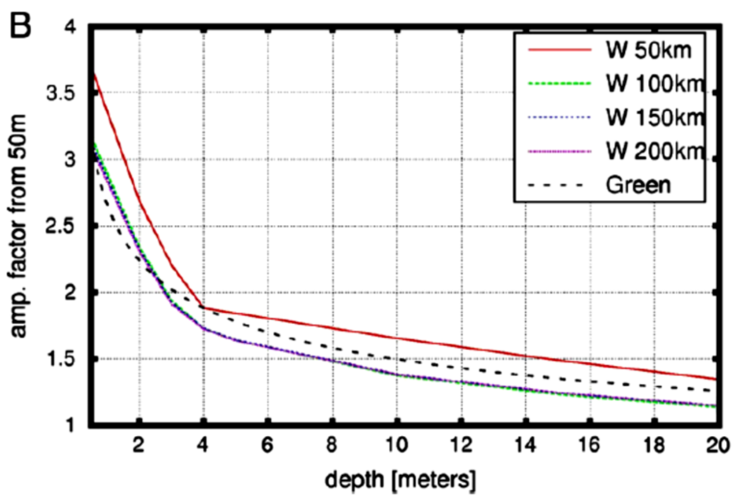


Figure 2.5 Amplification factor of the water level from -50 m water depth (Lovholt et al. 2012)

Lovholt et al. (2014) also performed a global tsunami hazard assessment for infrequent events causing devastating economic and social damages. They focused on an earthquake with 500 year return period which can generate tsunami hazard and investigated deterministic and probabilistic tsunami hazard assessment. Similar run-up calculation method to those used in Lovholt et al. (2012) was applied. The run-up calculation method proposed by Lovholt et al. (2012; 2014) is used to calculate tsunami wave heights at 1 m water depth in this thesis.

2.6 Risk Assessment

Traditionally, risk assessment is performed considering only economic (monetary) consequences and social and environmental aspects are neglected because, economical assessment of the risk can be easily carried out using monetary outcomes of the damage. Recently, the importance of the evaluation of different aspects of risk is realized and multi-dimensional risk analysis has been conducted for various natural hazards (Nadim and Glade, 2006; Correno et al. 2007; Cardona et al. 2010; Sørensen et al. 2012; Lane et al. 2013; Horspool et al. 2014; Necmioglu, 2014; Goda and Abilova, 2016). For example, Meyer et al. (2009) conducted a study on flood risk assessment, hazard mapping and risk mitigation across the Molde River in Saxony, Germany, which was heavily affected by the flood in 2002. Flood risk management was divided into two parts. The first part was the assessment and analysis of the risk where the second part consisted of planning, evaluation and risk reduction. Meyer et al. (2009) developed a multicriteria flood risk assessment (MCA) and mapping approach to create a reliable overall risk assessment, which consists of social, environmental and economic aspects.

To satisfy overall risk assessment requirements, Meyer et al. (2009) suggests the following guidelines:

- Different evaluation methods should be determined for different risk dimensions.
- Risk maps should be generated for the selected region to assess risk criteria in a distinguished way.
- All risk maps should be gathered using proper multicriteria decision methods to generate an overall risk assessment and mapping.

Damage-probability curve is the most frequently used method to evaluate the impact of the flood damage. Although the estimation of the expected annual damages involves many uncertainties, it can be estimated by considering the relationship between the damage and exceedance probability (Arnell, 1989; Messner et al. 2006). Meyer et al. (2009) calculated the risk by integrating the area under damage-probability curve (DVWK, 1985):

$$\overline{D} = \sum_{i=1}^{k} D[i] \Delta P_i \tag{2.4}$$

$$D[i] = \frac{D(P_{i-1}) + D(P_i)}{2} \tag{2.5}$$

where $\overline{D}$ is the annual average damage, $D[i]$ is the mean damage of two unknown points of the curve and ΔP_i is the probability of the interval between those points. $D(P_{i-1})$ is the damage at point (P_{i-1}) and $D(P_i)$ is the damage at point (P_i). A sample damage – probability curve is given in Figure 2.6.

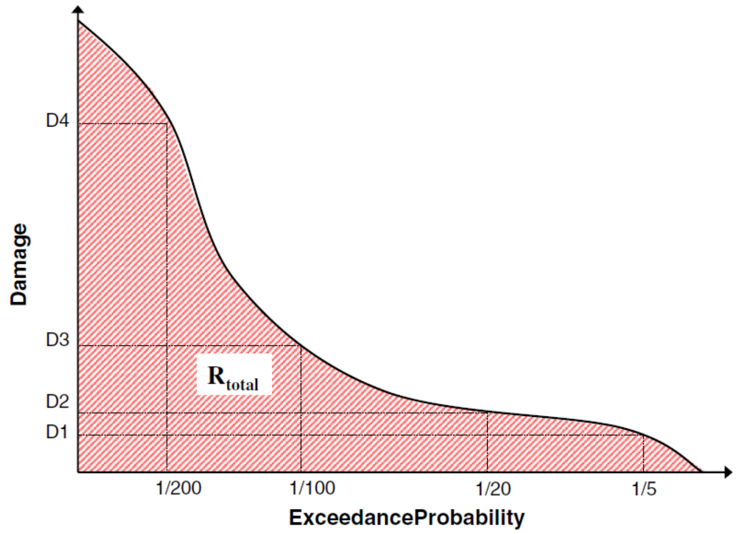


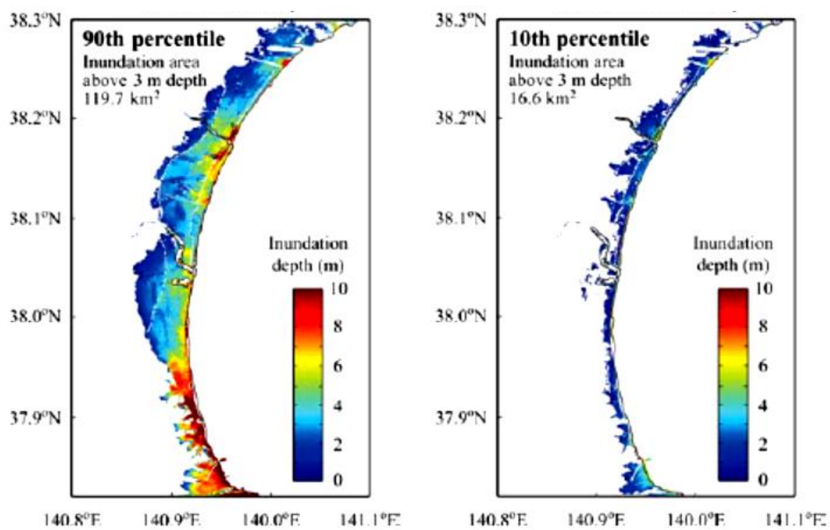
Figure 2.6 Damage – probability curve (Meyer et al. 2008)

In this thesis, social and economic risk assessment is carried out based on the methodology proposed by Meyer et al. (2008). The environmental risk assessment is conducted based on the binary approach proposed by Kubal (2009).

A number of studies related with tsunami hazard and risk assessment are given in the following paragraphs. Several tsunami simulation studies have been conducted especially within the last two decades. Two major natural disasters such as 2004 Indian Ocean earthquake and tsunami and 2011 Tohoku earthquake and tsunami have been influential in this issue. For example, Goda et al. (2016) performed a stochastic tsunami simulation as a case study along Tohoku region, Japan. Two different scenarios (i.e. M_w8.5 and M_w9.0) were applied. The main goal of their case study was to demonstrate the implementation of the proposed earthquake source parameter prediction model for a real event. Goda et al. (2016) performed 100 Monte Carlo simulations for each scenario (e.g. M_w8.5 and M_w9.0) to generate sufficient number of earthquake source parameters. Then, tsunami simulations were conducted to evaluate inundated areas in the selected region.

Probabilistic distribution of inundated areas along the coastline was determined based on Monte Carlo simulation results. Monte Carlo simulations are used in this thesis as well. However, based on an analysis conducted to understand the impact of the number of simulations on risk, 1000 MC simulations are selected to generate reliable risk estimates in this study.

Another probabilistic tsunami hazard assessment study was conducted by Suppasri et al. (2013) along Sendai coastline. Tsunami hazard maps of Sendai coastline were generated for $M_w 9.0$ depending on the probabilistic analysis of inundation area above 3 m, which corresponds to level of major damage for wooden houses (see Figure 2.7).



(a) (b)

Figure 2.7 Tsunami hazard maps for $M_w 9.0$ depending on the probabilistic analysis of inundation area above 3 m. (a) 90^{th} percentile (b) 10^{th} percentile (Suppasri et al. 2013)

Strunz et al. (2011) conducted tsunami risk assessment in the framework of the German Indonesian Tsunami Early Warning System (GITEWS). The method was applied for the coastal areas of Southern Sumatra, Java and Bali. A comprehensive people-centered tsunami risk assessment and disaster risk reduction analysis were implemented to develop a scientific and technical approach for tsunami risk assessment. Following components was investigated to evaluate the risk.

- Hazard Assessment – provides information about the geographical extent of inundation and the probabilities that these areas are likely to be affected.
- Vulnerability Assessment – provides information about the losses and damages with respect to social, economic and environmental aspects.
- Preparedness Assessment – characterizes possible limitations, which inhibit the community to respond adequately and efficiently.

Papathoma et al. (2003) described a vulnerability approach to compile multiple parameters like natural, built environments and socio-demographics that promote to vulnerability assessment against tsunami. The approach utilized Geographic Information System (GIS) tools due to spatially variable structure of tsunami vulnerability assessment. In order to test this approach, Heraklion, Crete was chosen because of its developed infrastructure, economy and touristic popularity. They conducted a comprehensive tsunami vulnerability assessment using some identification parameters (e.g. built environment, social, economic and environmental data). High-resolution analyses were performed by collecting the necessary data for 759 building with physical site visit. Results of the study were given in GIS based environment for different end-users.

Correno et al. (2007) focused on a multidisciplinary risk evaluation method, which included not only economic losses, death toll, and physical damage, but also social aspects and recovery period after a catastrophic event in an urban center. Risk was defined as a function of the potential physical damage and the impact factor, which was the combination of the socio-economic aspect and the recovery capacity. Holistic approach was applied by generating seismic and physical indices in Bogota, the capital of Colombia and in Barcelona, Spain. The results showed that the impact factor and lack of resilience with respect to disaster recovery were similar for both cities.

Hancilar (2012) carried out a probabilistic tsunami hazard assessment (PTHA) study for Istanbul, Turkey to identify the physical and social aspects of tsunami risk. For this purpose, tsunamigenic seismic sources were investigated for the North Anatolian Fault branch lying under the Marmara Sea. Tsunamigenic seismic zone maps and geographical information for both Turkey and Marmara Sea region were presented. PTHAs were conducted using the results of "Simulation and Vulnerability Analysis of Tsunamis Affecting the Istanbul Coasts" project performed by OYO Co. (2007) for Istanbul Metropolitan Municipality. For this project, 42 tsunami simulations were generated for the earthquakes having the moment magnitude greater than 7. Built environment was classified based on building attributes (e.g. construction material, number of storey, and usage type). Critical infrastructures like piers, ports, oil stations etc. were other elements at risk along the coastline that are included in the analysis. At the end, it was concluded that western coasts are less risky than the eastern coastlines of Istanbul.

Jaimes et al. (2016) proposed an approach on probabilistic financial risk assessment involving uncertainties during an earthquake triggered tsunami event. Inundation depth was selected as some principal evaluation criteria for the financial risk assessment method. Historical data was used to follow the tsunami propagation throughout the land and to specify the occurrence frequency of the event. Elements at risk such as critical infrastructures, buildings and agricultural land were taken into account for the approach. Risk categories were assigned for every type of property depending on their vulnerability, location, physical condition, and economic value.

In all the studies mentioned above, either the risk assessment is performed for a small specific region or a single dimension of risk is calculated. However, in this thesis, we both construct a comprehensive risk assessment study including economic, social and environmental risk dimensions and deal with a large study area, namely East Mediterranean including 91 identified EaR from Cyprus, Egypt, Greece, Israel, Lebanon, Syria and Turkey.

In this study, calculation of economic damage for residential, industrial and agricultural damage classes are conducted using the approach proposed by Huizinga et al. (2017) for economic risk calculations. Details of the approach proposed by Huizinga et al. (2017) is provided in the following paragraphs.

Huizinga et al. (2017) prepared a technical report about global flood depth-damage functions for Joint Research Centre (JRC), European Commission. The report provided a new risk assessment approach for policy makers. The fractional depth-damage functions are developed based on literature review at the continent level. The depth-damage functions provided into the report can be used for not only flood risk assessment, but also tsunami inundations. Depth-damage functions were provided for 214 countries for the following damage classes:

- Residential
- Commerce
- Industry

- Transport
- Infrastructure
- Agriculture

Depth-damage functions are determined at continental level for all types of damage classes (see Table C.1 in Appendix-C).

Country specific maximum damage values (in Euros) for all damage classes are also compiled by Huizinga et al. (2017). Construction costs of residential, commercial and industrial buildings are determined for 214 countries from the catalogues provided by Harris, 2010; Gardiner and Theobald, 2012; Turner and Townsend, 2013. The data collected from the catalogues is aggregated to estimate a single damage value for these damage classes. Regression analyses are also constructed to extrapolate construction costs to the countries for which values are not available using socio-economic parameters provided by World Development Indicators (WDI). Damage values (€/m^2) of residential and industrial buildings (with 2010 prices) are shown in Table C.2 in Appendix-C. Maximum agricultural damage value was also calculated directly related to loss of crops due to inundation (Bremond et al. 2013; Blanc et al. 2010). Agricultural damage calculation was conducted based on agricultural land and value data retrieved from World Development Indicators (WDI). Maximum damage values were added as Euros per hectare (€/ha) in the project (Huizinga et al. 2017) (see Table C.2 in Appendix-C).

A modified version of the social risk calculation method proposed by DVWK, (1985) is developed and used in this study. The number of physically damaged people in the affected area is taken as the consequence for social risk calculations. A vulnerability coefficient is calculated based on country specific values such as GDP/capita, literacy rate, age class under 65 years old and tsunami awareness parameter. A country-based awareness factor is assigned to the countries used in this thesis. Social risk is calculated using the number of physically damaged people and the vulnerability coefficient.

2.7 TEWS Positioning

Positioning of a Tsunami Early Warning System (TEWS) based on people-centered social risk reduction is investigated in this study as a second goal. A comprehensive literature survey is performed to analyze evacuation strategies after tsunami warning applied all around the world (Koike et al. 2003; Adams and Jordaan, 2005; Groen et al. 2010; Spahn et al. 2010; Ozel et al. (2012). First, literature review on the evacuation means are given. Then, the studies on TEWS positioning are summarized in the following paragraphs.

North-Eastern Atlantic and the Mediterranean Tsunami Information Centre (NEAMTIC) and Intergovernmental Oceanographic Commission of UNESCO (UNESCO-ICO) prepared a guideline for tsunami evacuation procedures for hotels (Guides, 2012). The guideline leads hotel administration to perform a regular evacuation plan for their guests, visitors and staffs in case of tsunami. In this guideline, it is stated that that two different evacuation plans can be applied in case of emergency:

i. Multi-story hotel building and facilities can be used as an evacuation center for the guests and staffs.
ii. Evacuation place can be determined at higher ground and evacuation maps, routes and signs should be provided for the residents in advance.

Some advices are listed about the precautions that can be taken by the hotel administration in case of emergency as well (Guides, 2012).

A tsunami preparedness and evacuation guideline brochure was prepared by California Geological Survey and The California Office of Emergency Services for marinas depending on the lessons learned after the Tohoku earthquake and tsunami in 2011 (Web 2.5). There are some advices for the boat owners and the people in the harbor according to the situation they are in. It is suggested that both the natural warnings like ground shaking, load ocean roar, and unusual sea withdrawal and the official warnings broadcasted by media and outdoor siren etc. should be taken into consideration. Those who are in port when the time of warning must abandon their boots and escape to high places. Those who are on the shallow water near the coastline must turn back to the harbor and leave the harbor within ten minutes. Those who are on water deeper than 183 meter (600 feet) are already at a safe place for tsunami waves.

The International Tsunami Information Center (ITIC) compiled a booklet, which includes historical and potential tsunami sources after the 2010 Chile tsunami (ITIC, 2017). This booklet also contains true stories of the witnesses from Chile, Hawaii, and Japan about the great Chilean earthquake and tsunami in 1960. Richter magnitude of the 1960 Chilean earthquake was 9.5 and effected almost all the coastlines around the Pacific Ocean. More than 2000 people lost their lives in Chile, 61 in Hawaii, 139 in Japan and 23 in Philippines. Total economic damage of the earthquake was estimated as 624.5 million USD in 1960. In 2010, after 50 years from the Chilean earthquake, same region encountered an enormous earthquake and tsunami again. These two disasters forced the authorities to compile a guideline based on scientific data and experiences. The booklet summarized lessons-learned from the past experiences (ITIC, 2017):

i. Earthquake itself can be a natural warning for the tsunami.
ii. Experiences of the survivors may help to beware of the adverse effects of the tsunami.

iii. When tsunami generated after an earthquake, an unusual sea withdrawal is observed. Beware of this natural warning and take necessary precautions.
iv. Tsunami lasts several hours or even a day. Find a safe place and be patient.
v. Mind the official warnings and follow the guidelines provided by the authorities.
vi. Leave belongings and go to the upper stores of a multi-story building.
vii. Roads may crack due to the earthquake before the tsunami. Do not count on the roads as an evacuation method.
viii. If it is too late to escape from the tsunami, just climb a tree or climb on something that floats. Land altitude may change due to the earthquake and tsunami. Beware of the tidal waves after the earthquake.
ix. Help your neighbors and other people till the official help comes.

Although there are many ways to survive in case of a tsunami as explained above, it is assumed in this thesis that the only way to save one self from the tsunami hazard is to move to a safe altitude on foot. This assumption is made since both the detailed topography and the locations of the buildings, safe spots etc. in the settlement area are not available. In order to warn people about an arriving tsunami wave, TEWS had to be placed at proper locations. The following studies were performed on TEWS positioning.

Blackford and Kanamori (1995) stated that not every earthquake generates a tsunami. Due to this fact, a tsunami warning received from the detectors should be reliable. Otherwise, reaction of the community and local governments gradually reduce for every unfaithful alarm. Additionally, there may be waste of money to take unnecessary precautions like evacuation of the population to the safe locations can cost millions of dollars.

Braddock and Carmody (2001) worked on six different sides in order to identify the optimum locations of tsunami early warning detectors. They formulated a nonlinear integer optimization problem and used enumeration techniques to solve it. The aim of the problem is to obtain maximum early warning potential for a probable tsunami using small number of detectors installed at optimum locations. They showed the formulation and solution of the optimal location problem of the tsunami detectors as an integer programming problem. They conclude that, only three detectors are enough to accomplish the maximum early warning potential for both the Pacific Ocean and the USA.

Audet et al. (2008) introduced a new optimal placement method of tsunami early warning buoys named Mesh Adaptive Direct Searches. They focused on the buoys and their placement optimization using a direct search algorithm. The constraints of the optimization method are education level of the affected population, reliable detection mechanism and accurate prediction of tsunami, respectively. They created two groups. One of them dealt with the optimization and the other one was PMEL (Pacific Marine Environmental Laboratory) scientists. They examined the DART (Deep Ocean Assessment and Reporting of Tsunamis) monitoring system and faced with some technical difficulties like different technical languages are used in different countries. They stated that optimization requires defining proper decision variables, objective function and constraints. Ultimate goal of this model is to formulate the real world problem and provide some reliable solutions.

Liang et al. (2015) worked on an optimization exercise for positioning the DART buoys in the South China Sea. The aim of the study was to mitigate the adverse effects of tsunamis from Manila Trench on the coastal settlements and infrastructures. It was concluded that the reaction time of the population living in the risky regions to tsunami alert plays the main role for disaster mitigation.

In this study, initially a set of discrete locations in the Eastern Mediterranean are identified as TEWS locations based on some technical restrictions provided in the literature and analysis of inundated areas due to a large number of tsunami simulations. Maximization of social risk reduction is aimed for the countries having coastlines along the Eastern Mediterranean to select the best location among the identified set. Data corruption, weak signals, device malfunction, and unsuitable sea bottom conditions are main problems of improper positioning of early warning buoys (Audet et. al., 2005). To avoid such problems, TEWS positioning restrictions used in this study that area identified as a result of literature review are summarized below (Meining et al. 2005; Mofjeld, 2009; Joseph, 2011; Wächter et al. 2015; Liang et al. 2015; Web 2.7; Web 2.8; Web 2.9):

i. The TEWS needs to be far enough away from any potential earthquake epicenter to ensure that there is no interference between the earthquake signal at the TEWS and the sea-level signal from the tsunami. On the other hand, the TEWS needs to be close enough to the epicenter to enable timely detection of any tsunami and maximize the lead time of tsunami forecasts for coastal areas.
ii. TEWS must ideally be placed in waters deeper than 1000 m to ensure the observed signal is not contaminated by other types of waves that have shallower effects (e.g. surface wind-waves).
iii. International maritime boundaries must also be considered when deploying TEWS.
iv. TEWS should be placed outside of major shipping lanes.
v. TEWS should be placed on flat sea bed.

2.8 Tsunami Awareness

Awareness and preparedness are two vital issues that affect the outcome of a natural disaster. Therefore, a literature survey is conducted for defining the level of tsunami awareness of the countries in the study area. In this thesis, the level of human tsunami awareness is used in social risk calculations.

Çankaya et al. (2016) performed a study on tsunami human vulnerability for Yenikapı district in Istanbul, Turkey. They proposed an awareness parameter for tsunami hazard ranging from one (least-awareness) to ten (well-awareness) depending on their experience. The awareness coefficient for Turkey was assumed to be 3 out of 10. However, they do not give any information about the awareness parameter for other countries.

Shenhar et al. (2015) revealed the results of National Earthquake Campaign on Public Preparedness in Israel. Although the campaign exposed 42% of the whole population, only 23% of the citizens exposed to campaign admitted that their awareness is improved. Additionally, 37% of the population exposed to campaign said that they did nothing to prepare. It has been observed that public awareness of earthquake hazards has increased after the campaign. However, the preparedness of the people has not been increased as much as awareness.

Soffer et al. (2011) worked on earthquake mitigation in Israel by inspecting demographic/educational parameters. A questionnaire was conducted with 495 participants to measure the awareness and preparedness level against the earthquake hazard. The results showed that the people exposed to questionnaire were only moderately worried about the outcomes of an earthquake. Results were also depicted that women have more awareness and preparedness than men do.

Baytiyeh and Naja (2016) conducted a questionnaire among college students on defining earthquake preparedness in Lebanon. They also considered effects of fatalistic and denial beliefs on disaster preparedness. Depending on the results of the questionnaire, more than half of the students seemed to be aware of the hazard. However, preparedness for the hazard was adversely affected due to fatalistic and denial beliefs. They concluded that misinterpretations of the beliefs in the Middle East have adversely affected the awareness and preparedness against natural hazards.

Ample of studies and projects (TRANSFER, ASTARTE, TSUMOSLIDE, RISK-KIT, PEARL, SHARE etc.) have been conducted on socio-economic vulnerability, adaptation, risk mitigation, and disaster management issues for European countries (i.e. Cyprus and Greece) including Turkey (Giardini et al. 2013,2014; Web 2.3). Unfortunately, most of these projects remained as scientific investigations and did not shed light on public awareness of tsunamis especially in Turkey. However, people living in European countries including Turkey are more conscious about tsunami awareness than the Middle East countries (Giardini. 1999).

After examining all these studies conducted on tsunami awareness, a tsunami awareness coefficient for each country found in the study area is proposed in this study. Tsunami awareness coefficient is used together with a number of vulnerability indicators in social risk calculations as explained in Section 3.4.1.2.

3 METHODOLOGY

3.1 Overview of the Methodology

Even though tsunamis are rarely experienced events they have enormous potential to cause large economic destruction on the critical infrastructures and facilities, social devastation due to mass casualty, and environmental adverse effects like erosion, accumulation and inundation. Thus, modeling tsunamis and evaluating associated risks are important.

In this study, a new methodology is proposed to evaluate economic, social and environmental risks due to tsunamis. Then also a new approach is devised to select the best location among a set of potential Tsunami Early Warning System (TEWS) locations based on reductions in social risk. The proposed methodology is summarized in Figure 3.1. Since the proposed approach is demonstrated on the Eastern Mediterranean coast, first, the case study area is introduced in this chapter. Then risk assessment, its inputs and outputs and TEWS positioning are explained in detail.

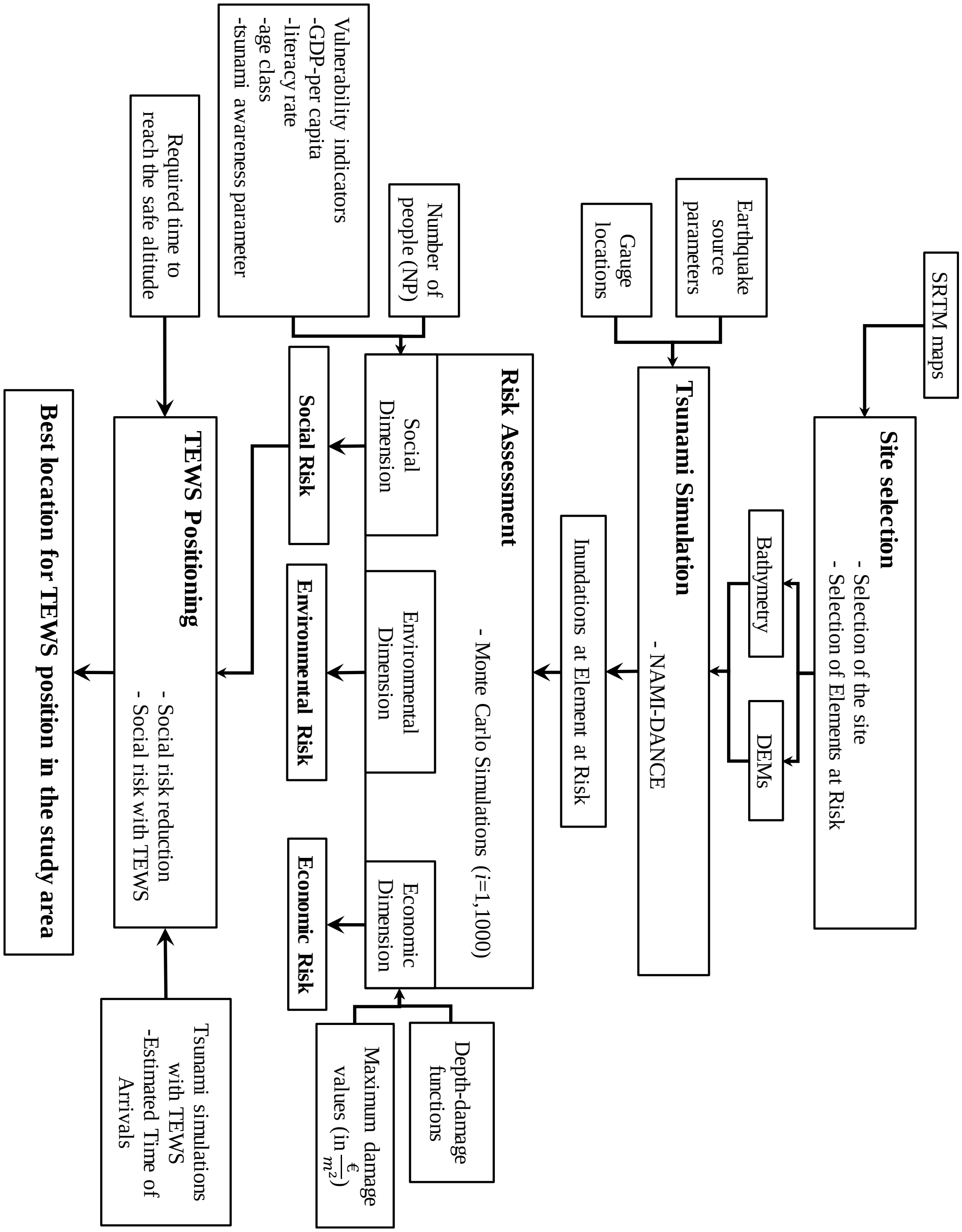


Figure 3.1 Proposed methodology

3.2 Study Area

Eastern Mediterranean is positioned in Alps-Himalaya continental shelf. This is a zone that produces 15% of earthquakes worldwide (Altinok et al. 2001). People living in the region has experienced numerous destructive earthquakes and tsunamis because of the continuous seismic activity taking place along the Hellenic and Cyprus arcs. 96 historical tsunami events have been reported within the past 3 millenniums (Yolsal et al. 2007; Altinok et al. 2001).

East Mediterranean includes seven countries, Cyprus, Egypt, Greece, Lebanon, Israel, Syria and Turkey. Eastern Mediterranean Sea and coastlines of these seven countries form the study area (see Figure 3.2). Coordinates of the study area are 30.50°-38.00^{0}N/24.11-36.50°E.

Figure 3.2 Study area

In order to understand spatial distribution of social, economic and environmental dimensions of risk along the Eastern Mediterranean coastline, 91 Elements at Risk (EaR) in the study area are identified based on literature review and a detailed search conducted on Google Map. As a result, 91 EaR consist of city centers, agricultural areas, summer villages, airports, ports, marinas, and other industrial structures are identified from seven countries. Coordinates, the country they are located, approximate areas along with the evaluated risk dimensions are provided in Table 3.1. For residential and industrial elements, only the areas where buildings and facilities are located are included into the areas. Moreover, areas located above 15 m altitude are not included into the area calculations assuming that tsunami waves are unlikely to flood areas above 15 m altitude. The bathymetry of the Eastern Mediterranean Sea is generated using GEBCO software (Web 3.1) and the grid size of the bathymetry is 405 m x 405 m. This grid size is used for the tsunami simulation throughout the Mediterranean Sea. High-resolution (30 m x 30 m) digital elevation map (DEM) of each identified EaR in the study area is retrieved from Shuttle Radar Topography Mission (SRTM) and digitized in ArcGIS. These DEMs are used to identify inundated areas at each EaR. Locations of these 91 EaR are shown in Figure 3.3.

Table 3.1 List of EaR in the study area

EaR	Country	Coordinates		Approximate Area (km^2)	Population Density (people/km^2)	Economic Risk			Social Risk	Environmental Risk
		Latitude	Longitude			Residential	Industrial	Agricultural		
Akdeniz Summer Villages	Turkey	36.39	34.25	8.22	270	YES	NO	NO	YES	NO
Al Arish City Centre	Egypt	31.07	33.48	19.53	5150	YES	NO	NO	YES	NO
Alanya Coastal District	Turkey	36.32	32.02	10.78	186	YES	NO	NO	YES	NO
Alexandria City Centre	Egypt	31.12	29.55	271.71	1900	YES	NO	NO	YES	NO
Anamur Coastal District	Turkey	36.03	32.51	2.49	49	YES	NO	NO	YES	NO
Antalya Konyaalti	Turkey	36.51	30.37	10.70	300	YES	NO	NO	YES	NO
Arsuz Summer Villages	Turkey	36.25	35.54	4.66	104	YES	NO	NO	YES	NO
Batroun City Centre	Lebanon	34.15	35.39	0.46	175	YES	NO	NO	YES	NO
Beirut City Centre	Lebanon	33.53	35.32	5.64	4251	YES	NO	NO	YES	NO
Belek Summer Villages	Turkey	36.51	31.03	27.25	4548	YES	NO	NO	YES	NO
Crete Summer Villages	Greece	35.2	25.2	11.23	1935	YES	NO	NO	YES	NO
Dalaman City Centre	Turkey	36.46	28.48	7.79	60	YES	NO	NO	YES	NO
Demre City Centre	Turkey	36.14	29.59	15.59	55	YES	NO	NO	YES	NO

Erdemli City Centre	Turkey	36.36	34.18	3.56	65	YES	NO	NO	YES	NO
Fethiye City Centre	Turkey	36.39	29.07	12.83	50	YES	NO	NO	YES	NO
Finike City Centre	Turkey	36.17	30.08	3.39	73	YES	NO	NO	YES	NO
Gazimagusa City Centre	Cyprus	35.06	33.55	9.51	68	YES	NO	NO	YES	NO
Haifa City Centre	Israel	32.5	35.04	37.47	4162	YES	NO	NO	YES	NO
Heraklion City Centre	Greece	35.2	25.08	5.59	1400	YES	NO	NO	YES	NO
Iskenderun City Centre	Turkey	36.34	36.1	15.84	999	YES	NO	NO	YES	NO
Kazanlı City Centre	Turkey	36.48	34.45	1.04	65	YES	NO	NO	YES	NO
Kemer City Centre	Turkey	36.36	30.33	2.44	102	YES	NO	NO	YES	NO
Kizkalesi Summer Villages	Turkey	36.27	34.08	0.69	14	YES	NO	NO	YES	NO
Larnaca City Centre	Cyprus	34.55	33.37	19.54	2600	YES	NO	NO	YES	NO
Latakia City Centre	Syria	35.3	35.48	9.55	540	YES	NO	NO	YES	NO
Lebanon Summer Villages	Lebanon	34.23	35.47	0.84	2840	YES	NO	NO	YES	NO
Manavgat Coastal District	Turkey	36.46	31.23	25.24	98	YES	NO	NO	YES	NO
Mersa Matruh City Centre	Egypt	31.21	27.14	10.63	1423	YES	NO	NO	YES	NO
Mersin City Centre	Turkey	36.47	34.37	19.02	114	YES	NO	NO	YES	NO
Nahariyya City Centre	Israel	33	35.05	6.49	5306	YES	NO	NO	YES	NO

Port Said City Centre	Egypt	31.15	32.17	25.30	450	YES	NO	NO	YES	NO
Samandag City Centre	Turkey	36.05	35.58	4.30	267	YES	NO	NO	YES	NO
Sariseki City Centre	Turkey	36.4	36.13	1.16	100	YES	NO	NO	YES	NO
Susanoglu S. Villages	Turkey	36.22	34.08	8.32	400	YES	NO	NO	YES	NO
Tartus City Centre	Syria	34.53	35.53	2.86	400	YES	NO	NO	YES	NO
Tartus Summer Villages	Syria	34.51	35.53	0.68	90	YES	NO	NO	YES	NO
Tasucu City Centre	Turkey	36.19	33.53	7.25	45	YES	NO	NO	YES	NO
Tel Aviv City Centre	Israel	32.05	34.46	8.02	8354	YES	NO	NO	YES	NO
Tripoli City Centre	Lebanon	34.26	35.49	6.02	5557	YES	NO	NO	YES	NO
Turkler Summer Villages	Turkey	36.36	31.49	7.60	4044	YES	NO	NO	YES	NO
Yemiskumu S. Villages	Turkey	36.29	34.1	0.19	1557	YES	NO	NO	YES	NO
Abu Qir Industrial Zone	Egypt	31.17	30.04	2.87	5000	NO	YES	NO	YES	NO
Abu Qir Port	Egypt	31.19	30.04	1.38	1030	NO	YES	NO	YES	NO
Alexandria Airport	Egypt	31.11	29.56	3.13	1820	NO	YES	NO	YES	NO
Ashdod Port	Israel	31.49	34.39	17.85	586	NO	YES	NO	YES	NO
Ashkelon Seawater Desalination Plant	Israel	31.37	34.32	6.49	284	NO	YES	NO	YES	NO
Beirut Airport	Lebanon	33.48	35.29	6.20	9261	NO	YES	NO	YES	NO
Beirut Port	Lebanon	33.53	35.31	3.25	1138	NO	YES	NO	YES	NO

Dalaman Airport	Turkey	36.42	28.47	6.43	10112	NO	YES	NO	YES	NO
Gazimagusa Port	Cyprus	35.07	33.56	0.58	391	NO	YES	NO	YES	NO
Haifa Airport	Israel	32.48	35.02	0.58	181	NO	YES	NO	YES	NO
Haifa Port & Industrial Zone	Israel	32.48	35	11.00	261	NO	YES	NO	YES	NO
Heraklion Airport	Greece	35.2	25.1	1.25	11496	NO	YES	NO	YES	NO
Herzliya Marina	Israel	32.09	34.47	0.37	261	NO	YES	NO	YES	NO
Iskenderun Iron & Steel Port	Turkey	36.44	36.12	5.79	2817	NO	YES	NO	YES	NO
Iskenderun Port	Turkey	36.35	36.11	3.79	137	NO	YES	NO	YES	NO
Koubba Industrial Zone	Lebanon	34.16	35.39	0.41	654	NO	YES	NO	YES	NO
Larnaca Airport	Cyprus	34.52	33.36	2.50	14706	NO	YES	NO	YES	NO
Latakia Port	Syria	35.31	35.46	2.63	3000	NO	YES	NO	YES	NO
Marina Dbayeh	Lebanon	33.55	35.35	0.13	258	NO	YES	NO	YES	NO
Mersin Port	Turkey	36.48	34.39	4.93	1410	NO	YES	NO	YES	NO
MMK Metalurgy Port	Turkey	36.46	36.12	0.64	4314	NO	YES	NO	YES	NO
Palmachi Air Base	Israel	31.54	34.42	10.4	No info	NO	YES	NO	NO*	NO
Paphos Int. Airport	Cyprus	34.43	32.29	2.23	4109	NO	YES	NO	YES	NO
Port Akdeniz	Turkey	36.5	30.36	2.25	1198	NO	YES	NO	YES	NO
Port Said Airport	Egypt	31.16	32.14	1.24	121	NO	YES	NO	YES	NO
Port Said	Egypt	31.14	32.18	5.67	979	NO	YES	NO	YES	NO
Tartus Port	Syria	34.54	35.57	3.64	3000	NO	YES	NO	YES	NO
Tirtar Yatch Marina	Turkey	36.31	34.13	0.15	278	NO	YES	NO	YES	NO
Tripoli Port	Lebanon	34.27	35.49	3.92	550	NO	YES	NO	YES	NO

Cairo Agricultural Area	Egypt	30.54	31.06	21925	4 (NP/ha)	NO	NO	YES	YES	NO
Cukurova Agricultural Area	Turkey	36.45	35.14	2306	1 (NP/ha)	NO	NO	YES	YES	NO
Dalaman Agricultural Area	Turkey	36.46	28.48	80	7 (NP/ha)	NO	NO	YES	YES	NO
Samandag Agricultural Area	Turkey	36.03	35.58	19	3 (NP/ha)	NO	NO	YES	YES	NO
Tartus Agricultural Area	Syria	34.38	36	1.13	5 (NP/ha)	NO	NO	YES	YES	NO
Akkuyu NPP Construction Site	Turkey	36.08	33.32	0.84	4044	NO	NO	NO	YES	YES
Alexandria Oil Refinery	Egypt	31.16	30.05	1.31	5500	NO	NO	NO	YES	YES
Alpet Oil Filling Facility	Turkey	36.49	34.43	0.59	29	NO	NO	NO	YES	YES
IPT Terminals Aamchit	Lebanon	34.08	35.37	0.04	361	NO	NO	NO	YES	YES
Antalya WWTP	Turkey	36.5	30.35	0.15	30	NO	NO	NO	YES	YES
Apec Oil Refinery	Lebanon	34.27	35.51	0.04	499	NO	NO	NO	YES	YES
Atas Oil Refinery	Turkey	36.49	34.41	1.42	400	NO	NO	NO	YES	YES
Cimenterie Nationale Lebanon	Lebanon	34.2	35.43	0.26	550	NO	NO	NO	YES	YES
Deir-Ammar CCGTPP	Lebanon	34.27	35.53	0.17	2300	NO	NO	NO	YES	YES
Iskenderun Iron and Steel Factory	Turkey	36.41	36.12	1.64	5262	NO	NO	NO	YES	YES
Jiyeh CCGTPP	Lebanon	33.38	35.24	0.20	3157	NO	NO	NO	YES	YES

Karaduvar WWTP	Turkey	36.48	34.42	0.17	240	NO	NO	NO	YES	YES
Kemer WWTP	Turkey	36.35	30.34	0.03	250	NO	NO	NO	YES	YES
Port Said WWTP	Egypt	31.13	32.17	0.57	117	NO	NO	NO	YES	YES
Soda Chemical Industry	Turkey	36.48	34.43	1.02	2547	NO	NO	NO	YES	YES
Tripoli WWTP	Lebanon	34.27	35.5	0.24	188	NO	NO	NO	YES	YES

* Palmachi Air Base is a military base and there is no clear information about the number of soldiers.

Figure 3.3 EaR identified in the study area

3.2.1 Compilation of Earthquake Data for the Study Area

As explained in Section 2.2, a number of earthquake catalogues are available; however, they do not provide all of the source parameters such as fault length, fault width, displacement, strike angle, dip angle and rake angle. Based on the data requirements of the current study, the earthquake catalogue compiled by EU funded TRANSFER (Tsunami Risk ANd Strategies For the European Region) Project (Web 2.4) is selected and used here. The catalogue contains all the necessary source parameters of historical earthquakes with their references (see Appendix-A). An example entry for the earthquake numbered 6545 from TRANSFER earthquake catalogue is given in Table 3.2.

Table 3.2 An example entry from TRANSFER earthquake catalogue

OBJECT ID	Latitude	Longitude	Locality	Verified Date	Strike
6545	35.1	26.6	Hellenic subduction zone	30/04/1992	172

Dip	Rake	Magnitude	Depth	Direct Reference Authors	Direct Reference Title
38	-106	6.1	20	Bohnhoff M., Harjes H.P. and T. Meier	Deformation and stress regimes in the Hellenic subduction zone

Direct Reference	Direct Reference Year	Indirect Reference Authors	Indirect Reference Title	Indirect Reference	Indirect Reference Year
J. Seismol., 9, 341-366	2005	Papazachos B.C., Kiratzi A. and E. Papadimitriou	Regional Focal Mechanisms for Earthquakes in the Aegean Area	Pure Appl. Geophys. (PAGEOPH), 126, 4, 405-420	1991

Historical earthquake data compiled from TRANSFER project covers earthquakes from 1900 to 2013, a period of 113 years. 523 historical earthquakes originating in the Eastern Mediterranean Sea are selected and used in the Monte Carlo simulations of this study. From here on, the collection of 523 earthquakes will be referred to as Thesis Earthquake Data Set (TEDS). Locations of these 523 historical earthquakes are shown as red stars in Figure 3.4.

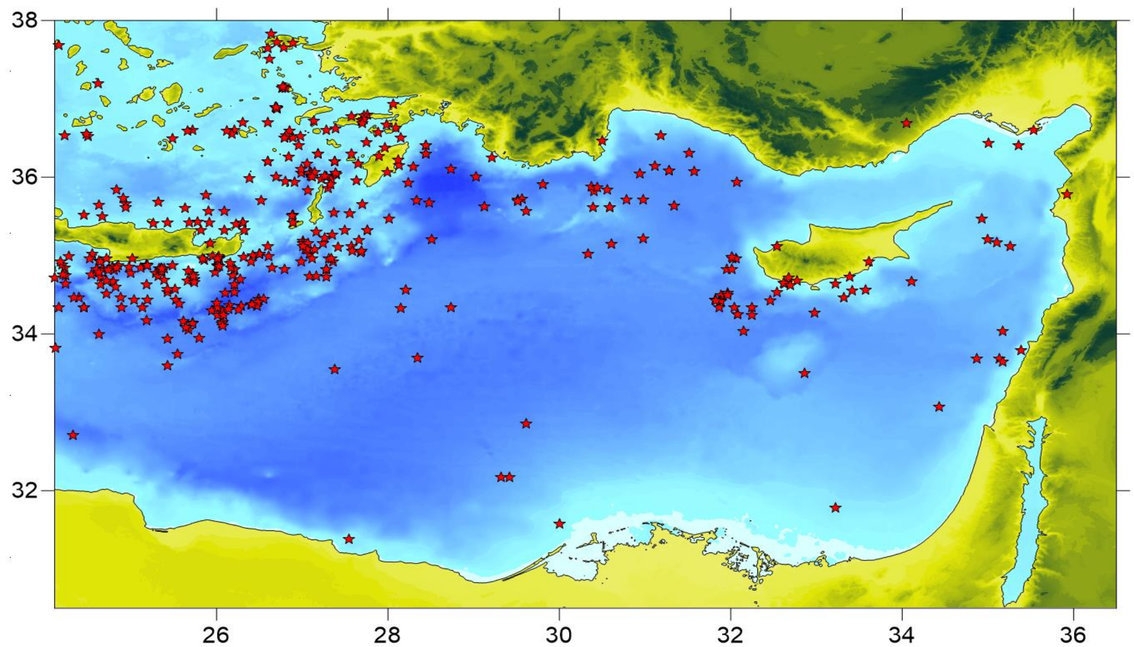


Figure 3.4 Locations of the historical earthquakes retrieved from TRANSFER project

3.3 Coastal Tsunami

Tsunami risk assessment is at the core of this study. Economic, social and environmental risks for each EaR are calculated through Monte Carlo simulations. Calculation of risk requires estimation of associated probabilities of the earthquakes and their consequences. The most important consequence of a tsunami is inundation and there are also secondary consequences due to inundation. First, a large number of random earthquakes are generated, associated tsunamis are propagated to the coast and resulting inundation levels at each EaR are estimated. These inundation levels are used to calculate associated economic, social and environmental consequences. Monte Carlo simulations which are based on this data are explained in detail in the following paragraphs.

A random earthquake (RE) is generated from TEDS in each MC simulation. An earthquake is defined using the source parameters given in Table 3.3. Thus, to generate a RE, random values have to be assigned to all of these source parameters. The second column of Table 3.3 explains how numerical values are assigned to each source parameter of the RE in a given MC simulation. The flowchart of random earthquake generation is given in Figure 3.5.

Table 3.3 Value assignment for each earthquake source parameter in a MC simulation

Earthquake source parameter	**Approach used to assign the numerical value in each MC simulation**
Location (latitude and longitude)	Randomly sample one earthquake from TEDS, call this Earthquake_MC. Use the location of Earthquake_MC.
Strike, dip and rake angles	Use strike, dip and rake angles of Earthquake_MC.
Moment magnitude	Assign a pdf to moment magnitude using moment magnitudes of earthquakes found in TEDS; call this MM_pdf. Randomly sample one moment magnitude from MM_pdf (see Section 3.3.1 for details).
Focal depth	Assign a pdf to focal depth using focal depths of earthquakes found in TEDS; call this FD_pdf. Randomly sample one focal depth from FD_pdf (see Section 3.3.1 for details).
Fault length and width	Using regression equations developed by Wells and Coppersmith (1994) calculate fault length and width (see Section 3.3.2 for details).
Displacement	Calculate displacement using the equation suggested by Hanks and Kanamori (1979) (see Section 3.3.2 for details).

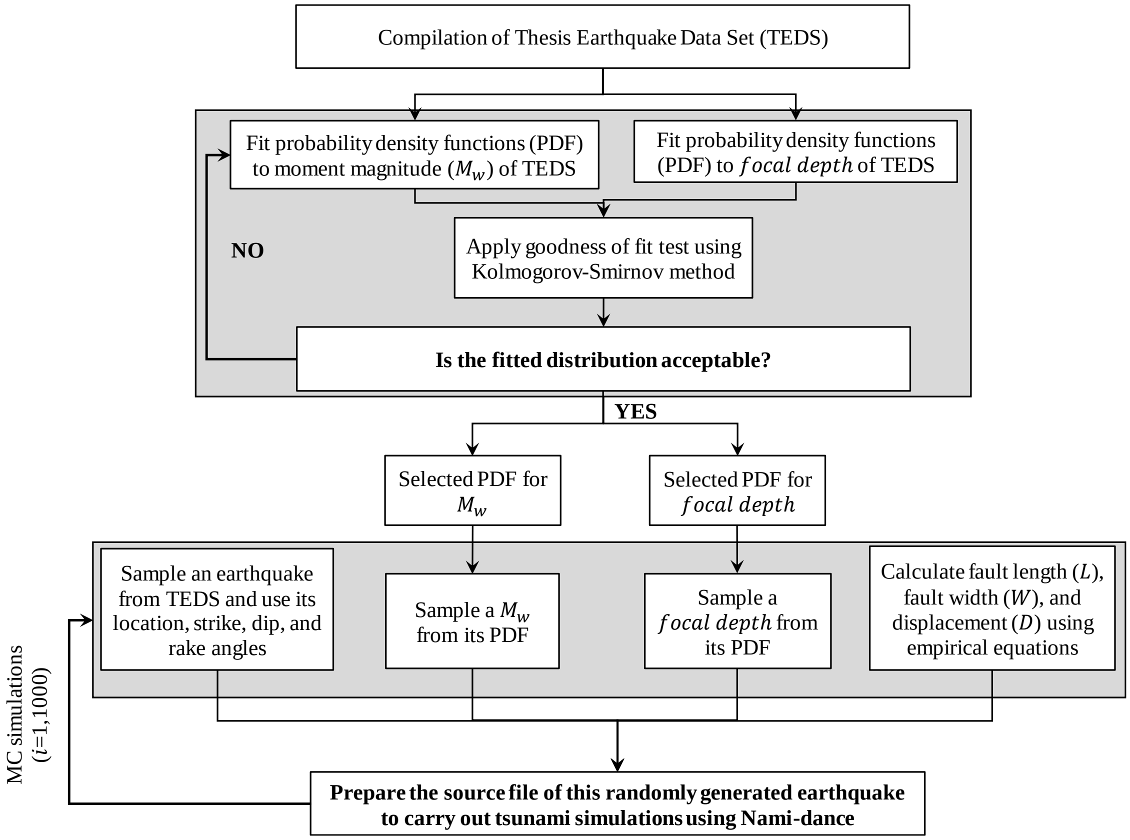


Figure 3.5 Flowchart of random earthquake generation

The location, strike, dip, and rake angles are fault attributes; thus, for each MC simulation these values are taken from the sampled earthquake, Earthquake_MC. Moment magnitude and focal depth are the independent variables; thus, they are sampled from the fitted pdf.s. Fault length, fault width and displacement are calculated using the analytic relations developed in the literature as explained in Section 3.3.2.

To obtain robust risk estimates, sufficient number of MC simulations has to be identified. Sufficient number of MC simulations is selected based on the change in the total economic and social risks with respect to the number of MC simulations plot. The small rate of change between the risk values means that the number of MC simulation is enough to obtain robust risk estimates. Total economic and social risks for 91 EaR identified at the coasts of Eastern Mediterranean are calculated for varying number of MC simulations (i.e. for 200, 500, 1000, 2000, and 5000 number of MC simulations are plotted in Figure 3.6 and Figure 3.7, respectively. Total economic and social risks are normalized with respect to the maximum total economic and social risks calculated and the normalized values are used in Figure 3.6 and Figure 3.7, respectively. NAMI-DANCE software is used to model tsunamis and country specific depth-damage curves are used to estimate economic risks (Details of economic risk calculation is provided in Section 3.4.2.1). As can be seen in Figure 3.6 and Figure 3.7, around 1000 MC simulations the total economic and social risks stabilize. Thus, it is concluded that 1000 MC is enough to obtain representative economic and social risk estimates for the study area.

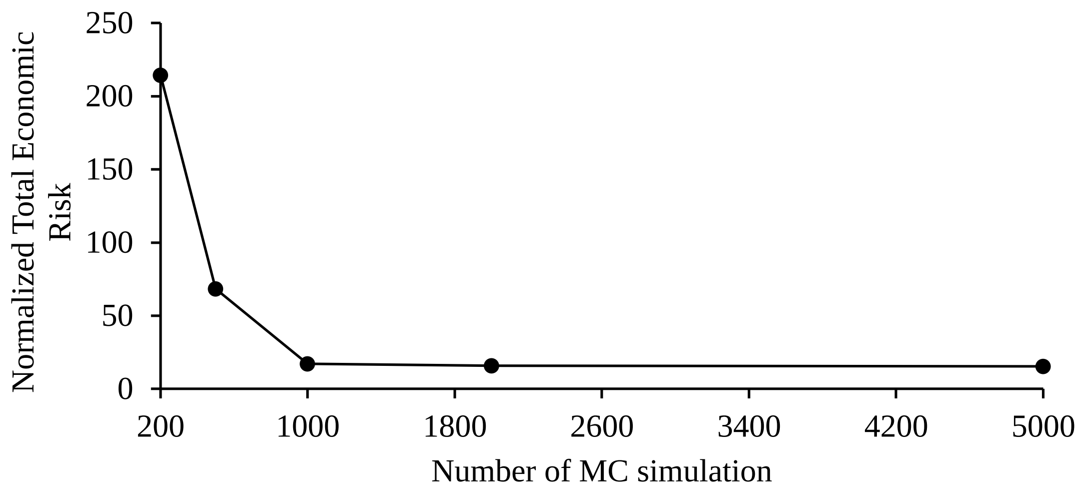


Figure 3.6 Change in total economic risk with the number of MC simulations

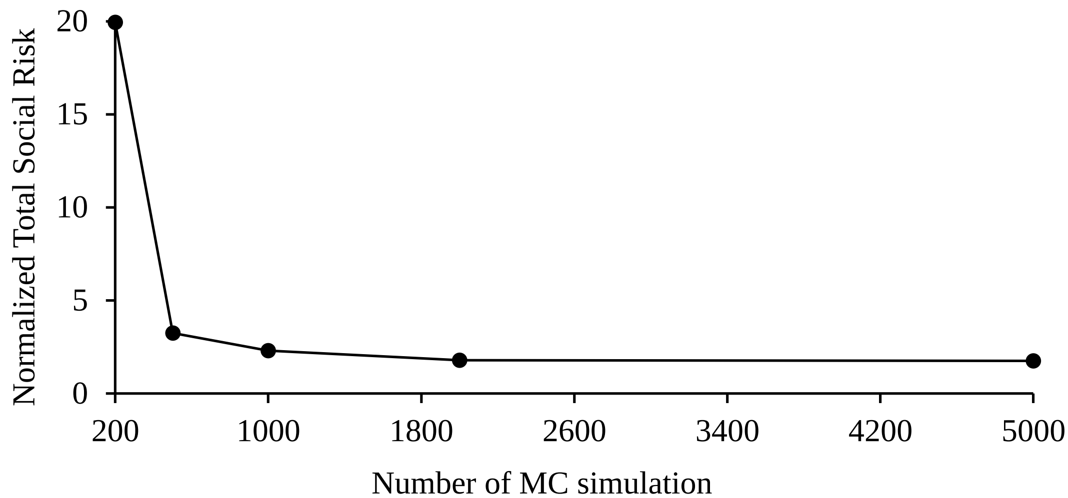


Figure 3.7 Change in total social risk with the number of MC simulations

3.3.1 Probability Density Function Assignment for Moment Magnitude and Focal Depth

Moment magnitude and focal depth are the independent earthquake source parameters. Thus, in each MC simulation, values for moment magnitude and focal depth are sampled from their related pdf.s. The pdf.s are developed using data from TEDS. Various sampling distributions are fitted to moment magnitude and focal depth obtained from TEDS. Then, Kolmogorov-Smirnov goodness-of-fit test is applied to those fitted distributions to identify the best-fitted distribution. Depending on the results of goodness-of-fit test, normal distribution and gamma distributions are selected for moment magnitude and focal depth, respectively according to their p-values. P-value is the calculated probability which shows the statistical significance level of the performed hypothesis against the null hypothesis. For example, for the confidence interval of 5%, the p-value smaller than 0.05 implies that the performed hypothesis is statistically significant. The smaller the p-value represents the higher the statistical significance level (Kul, 2014). Thus, normal and gamma distributions used for moment magnitude and focal depth, respectively had the smallest p-values among other tested distributions. Two sample distributions and their corresponding p-values are shown for both moment magnitude and focal depth in Table 3.4. Histograms and fitted distributions for moment magnitude (MM_pdf) and focal depth (FD_pdf) are shown in Figure 3.8 and Figure 3.9, respectively.

Table 3.4 Results of Goodness-of-fit test using Kolmogorov-Smirnoff method

Parameter	Distribution	Components	p-value	α-value
Moment Magnitude	Weibull	a=5.13472, b=5.38823	3.83E-07	0.01 - 0.05
	Normal	**mu = 4.73, sigma = 1.05**	**2.24E-11**	**0.01 - 0.05**
Focal depth	Lognormal	mu = 3.14, sigma = 0.87	8.19E-04	0.01 - 0.05
	Gamma	**a = 1.61, b = 20.11**	**6.07E-08**	**0.01 - 0.05**

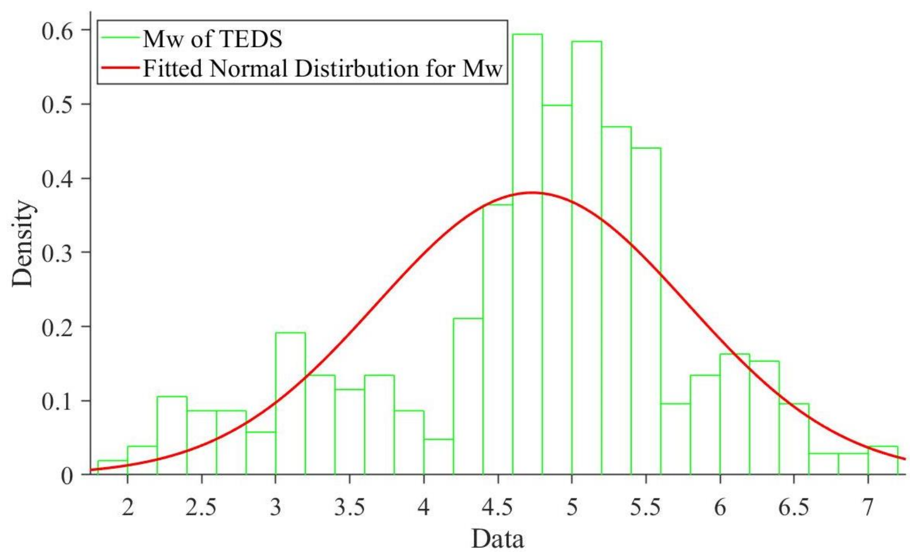


Figure 3.8 Histogram and fitted Normal Distribution for moment magnitude (MM_pdf)

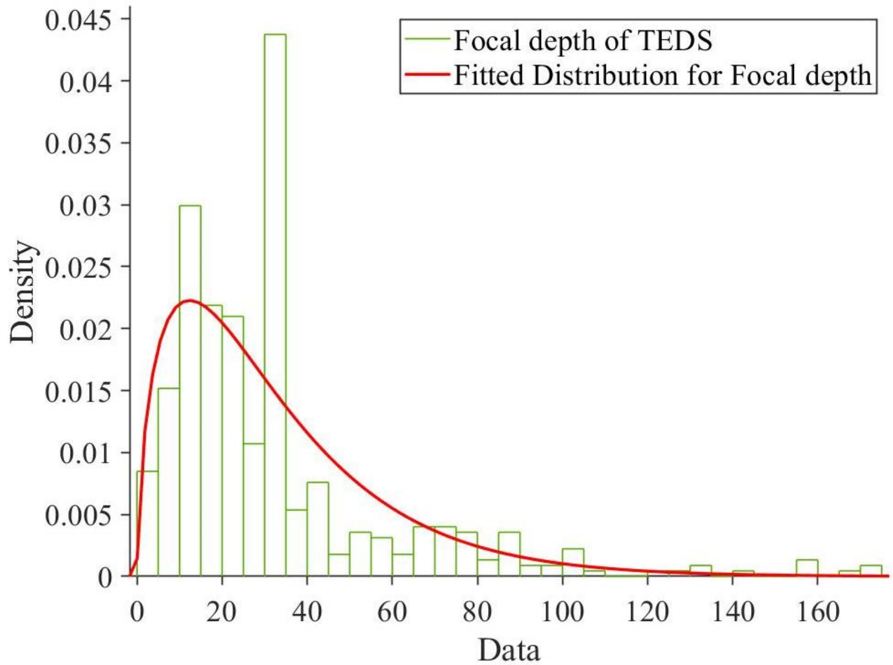


Figure 3.9 Histogram and fitted Gamma Distribution for focal depth (FD_pdf)

3.3.2 Calculation of Fault Length, Fault Width and Displacement

Hanks and Kanamori (1979) indicated that seismic moment, M_0 demonstrates the relationship between the source parameters and earthquake magnitude. For crustal faults, seismic moment can be formulated as (Hanks and Kanamori, 1979):

$$M_0 = \mu LWD \qquad (3.1)$$

where μ is the shear modulus of the crust (depends on the material type), L is the fault length, W is the fault width, and D is the displacement.

The relationship between the moment magnitude (M_w) and the seismic moment (M_0), of an earthquake is formulated as (Hanks and Kanamori, 1979):

$$M_w = {}^{2}/_{3}\, log(M_0) - 10.7 \tag{3.2}$$

Relationship between M_w and L, and M_w and W are investigated by different researchers as shown in Figure 3.10 and Figure 3.11, respectively. Wells and Coppersmith (1994) developed the following regression equations, which are the most commonly used relations:

$$M_w = 4.38 + 1.49 log(L) \tag{3.3}$$

$$M_w = 4.06 + 2.25 log(W) \tag{3.4}$$

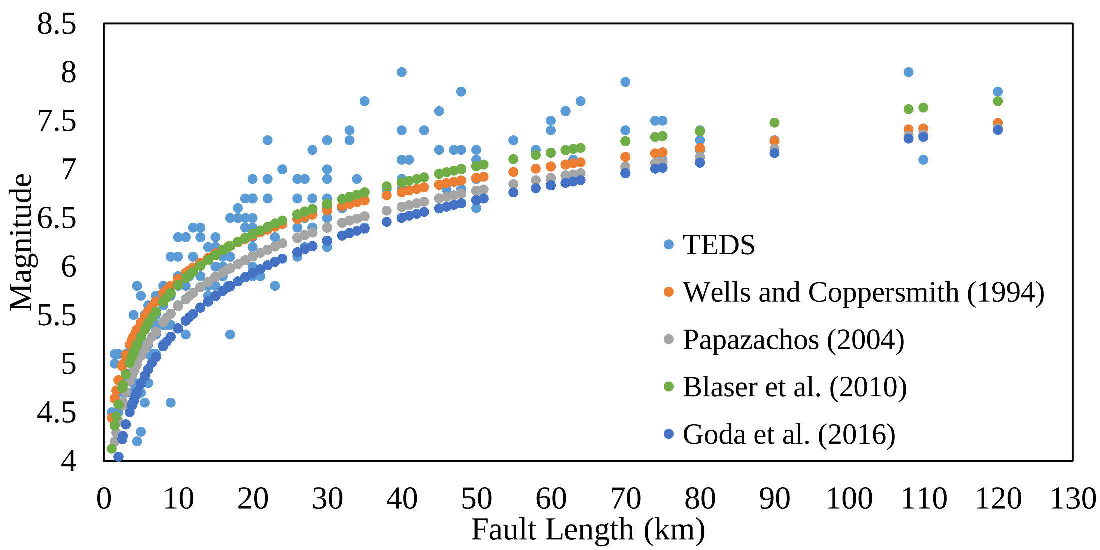


Figure 3.10 Comparison of fault length calculation from different sources

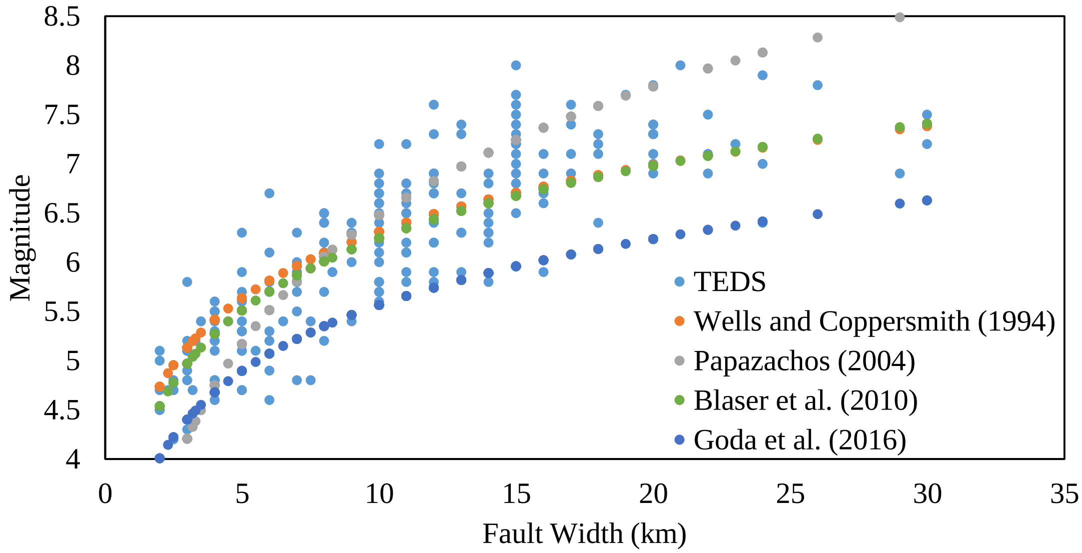


Figure 3.11 Comparison of fault width calculation from different sources

Regression equations for TEDS are developed as well:

$$M_w = 3.9049 + 0.8232\, ln(L) \tag{3.5}$$

$$M_w = 3.5232 + 1.2105\, ln(W) \tag{3.6}$$

Since these regression equations developed for TEDS are similar to those developed by Wells and Coppersmith (1994), without loss of generality their equations are used in this study. Once fault length and fault width are calculated using Equations (3.3) and (3.4), respectively, Equation (3.1) is used to estimate the displacement.

3.3.3 Tsunami Simulations

For each RE, an earthquake source file composed of earthquake source parameters of the RE is manually prepared and fed to NAMI-DANCE as input. The software generates a tsunami source based on the inputs. A sample tsunami source generated by NAMI-DANCE and the locations of these gauges are given in Figure 3.12. Since the study area is very large and it is not possible to obtain high resolution maps of the coasts of seven countries, NAMI-DANCE is not used to calculate the inundation levels at each EaR in this study. Instead, tsunami wave heights at 50 m water depth offshore from the EaR is obtained from NAMI-DANCE through the gauges placed along the coastline. Then, tsunami wave heights at 50 m water depths are carried to the coast using Green's Law. Inundation levels at each EaR are estimated using wave heights at the coast and elevations of EaR. The details of the calculation of inundation levels at each EaR are explained in the next section.

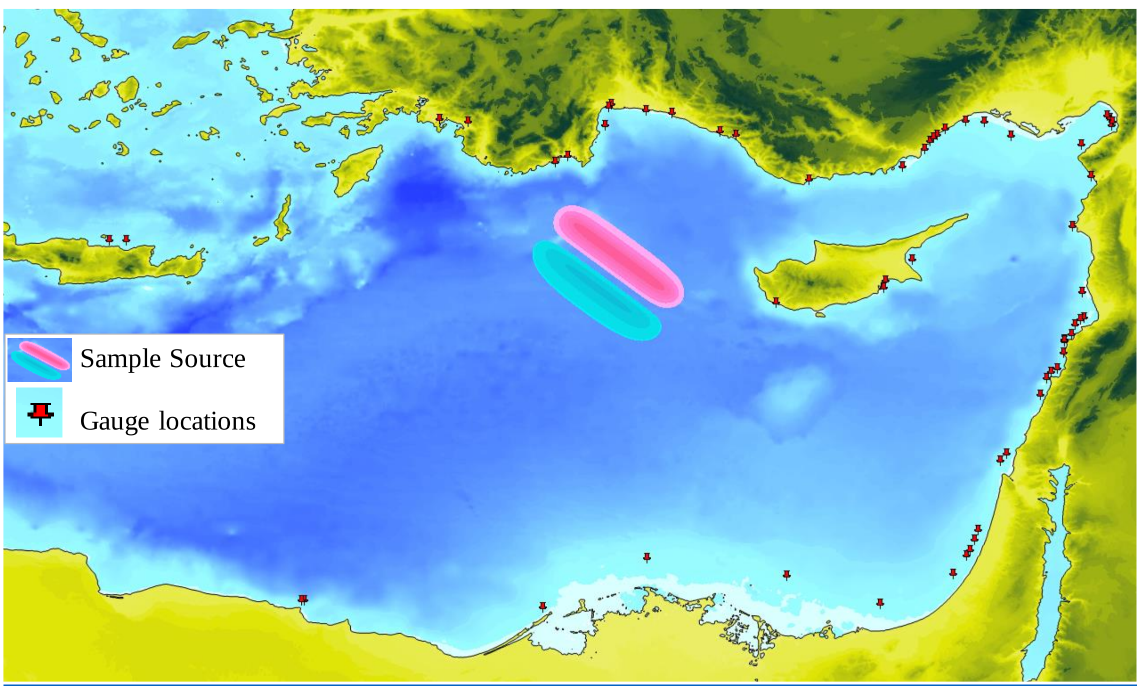


Figure 3.12 Sample earthquake source generated by NAMI-DANCE software and the locations of these gauges

NAMI-DANCE input parameters and their descriptions are shown in Table 2.1 in Section 2.1. The outputs of tsunami simulations conducted with NAMI-DANCE and their descriptions used in this thesis are shown in Table 3.5.

Table 3.5 NAMI-DANCE outputs

Property	**Description**
Arrival time of initial wave (min)	Estimated time of initial wave arrives to the gauge point
Arrival time of max.wave (min)	Estimated time of maximum wave arrives to the gauge point
Maximum (+)ve amp.(m)	Maximum positive tsunami wave height recorded at the gauge point
Maximum (-)ve amp.(m)	Maximum negative tsunami wave height recorded at the gauge point

3.3.3.1 Calculation of Inundation levels at EaR

In order to obtain reliable inundation levels at inland areas, the grid size of the bathymetry and topographic maps of the EaR should be very fine. Such maps are very difficult to obtain and processing time of the tsunami simulations are too long due to the fine grid sizes especially for large study areas such as the one used in this thesis. Moreover, the goal of this study is to estimate relative overall risks throughout the whole study area. Thus, for the sake of simplicity, Green's Law is used to carry tsunami wave heights recorded at the gauges implemented at 50 m water depth offshore to the coast. A similar approach was used by Lovholt et al. (2012) and Lovholt et al. (2014) and it was concluded that reliable results were obtained according to their investigations.

Synolakis (1991) revealed Green's law equation as follows:

$$\frac{H_1}{H_{50}} = \left(\frac{d_{50}}{d_1}\right)^{\frac{1}{4}} \tag{3.7}$$

where H_{50} and H_1 are the tsunami wave heights at 50 m and 1 m water depths, respectively and d_{50} and d_1 are 50 m and 1 m water depths, respectively. From this equation a tsunami wave height at 1 m, H_1, is estimated based on a tsunami wave height H_{50} at 50 m, which is obtained from the simulation.

Tsunami wave heights are recorded at 50 m water depth through the gauges using NAMI-DANCE software. Then these wave heights are used to calculate tsunami wave heights at 1 m water depth using Equation 3.7 for each EaR. As a conservative approach, the tsunami wave height at the coastline is assumed to inundate all the land below this altitude at the coast and the inundation level is assumed to be equal to the tsunami wave height at the coastline. An example of this assumption is introduced in Section 4.2.1.

3.4 Risk Assessment

According to ISO 31010, probability of a hazard and the consequences of that hazard create the risk. So, risk is defined as follows:

$$Risk = Probability * Consequence \tag{3.8}$$

where $Consequence$ represents the impact of an event or circumstance with economic, social and environmental dimensions and $Probability$ is the chance of occurrence of that event among the population of all events. For economic, social and environmental risks the consequences are referred to as economic, social and environmental damages, respectively.

In this study, economic, social and environmental dimensions of risk are calculated for the EaR identified in the study area. List of the EaR and considered risk dimensions for each EaR is shown in Table 3.1. Economic, social and environmental damage calculations are explained in detail in the following sections.

3.4.1 Calculation of Damages

3.4.1.1 Economic Damage

For economic risk dimension, damage on residential buildings, industrial facilities and agricultural areas are considered separately. Country specific damage values (in Euros) for different types of damage classes are calculated by multiplying the maximum damage values and depth-damage functions provided by Huizinga et al. (2017). Detailed explanations on maximum damage values and depth-damage functions are given in Section 2.6. Depth-damage functions at continental level and maximum damage values for residential, industrial and agricultural damage classes used in this thesis are given in Table C.2 in Appendix-C.

Based on the method proposed by Huizinga et al. (2017), economic damage for inundation level, i is calculated as follows:

$$ED_i = D_{max} C_i A_i \tag{3.9}$$

where i is the inundation level (i.e. i =1, 2,…, 6 m), ED_i is the economic damage (in Euros) for inundation level i, D_{max} is the maximum damage value (in $\frac{€}{m^2}$) with 2010 prices, C_i is the depth-damage function that specifies what ratio of the maximum damage occurs for inundation level i at continental level, and A_i is the inundated area for inundation level i.

The countries where 91 EaR are located are Cyprus, Egypt, Greece, Israel, Lebanon, Syria, and Turkey, and they are located in three continents, namely Africa, Asia, and Europe.

3.4.1.2 Social Damage

In this thesis, physical damage on people due to inundation caused by a tsunami is taken as the consequence of the social risk. Based on literature (Abt et al. 1989; Endoh and Takahashi, 1995; Jonkman et al. 2008), the minimum inundation level, which will cause physical damage on a person, is taken as 0.5 m in this study. The social risk calculation is carried out by assuming that the number of people at each EaR is uniformly distributed through the whole area of the EaR. Population densities of the countries are used to estimate the total number of people at each EaR. Thus, the total number of people, NP located within the area where wave height reaches 0.5 m or higher is taken as the consequence of the social risk. The social damage for an inundation level i, SD_i is calculated as follows:

$$SD_i = if \begin{cases} i < 0.5\ m, & 0 \\ i \geq 0.5\ m, & \sum NP_i\, C_{vul} \end{cases} \tag{3.10}$$

where NP_i is the number of people found in the inundated areas of EaR for inundation level i and C_{vul} is the vulnerability coefficient. The total number of people found in the inundated areas of EaR for inundation level i is calculated using the population density of the country and the inundated area as follows:

$$NP_i = p_d A_i \tag{3.11}$$

where p_d is the population density of the related EaR obtained from different databases (i.e. TUIK, Worldbank, CIA) and A_i is the inundated area for inundation level i.

In order to realistically estimate the social risk, vulnerability of people living in different countries are taken into consideration. In the literature, Gross Domestic Product (GDP) per capita, literacy rate and age class are commonly used as vulnerability indicators (Brooks et al. 2005; Birkmann and Fernando, 2008; Harris, 2010). Thus, GDP per capita, literacy rate and age class data are compiled from various sources such as Turkish Statistical Institute (TUIK), Worldbank, and CIA (Web 3.2; Web 3.3; Web 3.4). In addition to these three vulnerability indicators, tsunami awareness is identified as an important factor in the literature (see Section 2.8). Tsunami awareness differs from country to country due to their lifestyles, fatalistic and denial beliefs, demographic and educational parameters (Soffer et al. 2011; Baytiyeh and Naja, 2016). Thus, tsunami awareness, n is also included into the social risk calculations as a vulnerability indicator. A new tsunami awareness classification is proposed in this thesis for the countries in the study area. It is proposed that tsunami awareness parameter is selected from one (low awareness) to four (very high awareness) for the countries in the study area. Vulnerability indicators for the countries found in the study area are shown in Table 3.6.

Table 3.6 Vulnerability indicators for the countries

	Vulnerability Indicators			
Country	GDP($)*	Literacy rate**	Age class*** (<65)	n****
Cyprus	23542	0.991	0.879	3
Egypt	3478	0.738	0.958	1
Greece	17891	0.977	0.781	3
Israel	37181	0.978	0.887	3
Lebanon	8257	0.939	0.932	2
Turkey	10863	0.956	0.925	2
Syria	2058	0.864	0.958	1

* Retrieved from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

** Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/ly.html; http://www.tuik.gov.tr/UstMenu.do?metod=temelist

*** Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/ly.html; http://www.tuik.gov.tr/UstMenu.do?metod=temelist

**** Proposed in this study based on literature survey and expert opinions

Vulnerability indicators are normalized before they are used in social damage calculations. Normalization procedure is conducted by dividing the vulnerability indicator to the highest value of the related indicator among all the countries:

$$N_{GDP,Country} = \frac{GDP_{Country}}{GDP_{highest}},\ N_{literacy\_rate,Country} = \frac{literacy\_rate_{Country}}{literacy\_rate_{highest}},$$

$$N_{age\_class,Country} = \frac{Age\_class_{Country}}{Age\_class_{highest}},\ N_{n,Country} = \frac{n_{Country}}{n_{highest}} \tag{3.12}$$

where $N_{GDP,Country}$ is the normalized GDP at country level, $N_{literacy\_rate,Country}$ is the normalized literacy rate at country level, $N_{age\_class,Country}$ is the normalized age class (under 65 years old) at country level, $N_{n,Country}$ is the normalized tsunami awareness parameter at country level, $GDP_{Country}$ is the gross domestic product for country,

$Age\_class_{Country}$ is the age class (ratio of population under 65 years old) for country, $literacy\_rate_{Country}$ is the literacy rate for country, $n_{Country}$ is the tsunami awareness parameter for country, where $Country =$ Cyprus, Egypt, Greece, Israel, Lebanon, Syria, and Turkey. $GDP_{highest}$, $literacy\_rate_{highest}$, $Age\_class_{highest}$, and $n_{highest}$ are the highest gross domestic product, the highest literacy rate, the highest age class value and the highest tsunami awareness among the countries in the study area, respectively.

Then, the vulnerability coefficient, C_{vul} is calculated based on these indicators:

$$C_{vul} = \frac{1}{\frac{1}{4}\left\{N_{GDP,Country} + N_{literacy\_rate,Country} + N_{age\_class,Country} + N_{n,Country}\right\}} \quad (3.13)$$

Vulnerability coefficients for each country located in the study area are calculated and shown in Table 3.7.

Table 3.7 Vulnerability coefficients for the countries located in the study area

Country	C_{vul}
Cyprus	1.25
Egypt	1.92
Greece	1.32
Israel	1.09
Lebanon	1.52
Turkey	1.47
Syria	1.85

3.4.1.3 Environmental Damage

Some of the EaR are identified as environmental hazards. These are Nuclear Power Plants, Oil Refineries, Oil Filling Facilities, Chemical Industry, and Waste Water Treatment Plants. A binary approach is used in calculating the environmental damage: If the EaR, which is identified as an environmental hazard, is inundated then it is assumed that it will cause an environmental damage. Otherwise, there is no environmental damage at all.

The next stage is the calculation of three dimensions of the risk, namely economic, social and environmental risks that are explained in the following sections.

3.4.2 Calculation of Risk Dimensions

3.4.2.1 Economic Risk Calculation

In order to calculate the corresponding risk for each EaR, the probability distribution of the damage has to be calculated first. Economic risk is determined by calculating the area underneath the exceedance probability-damage curve for residential, industrial and agricultural components of the economic risk. In this study, exceedance probability-damage curve is constructed for each EaR using inundation levels resulting from 1000 MC simulations.

Construction of the exceedance probability-damage curve has three stages. These three stages are explained below using Fethiye City Center as the example EaR.

i. First, the exceedance probability-inundation level curve for each EaR is calculated. The exceedance probability-inundation level curve for Fethiye City Center is given in Figure 3.13 as an example.

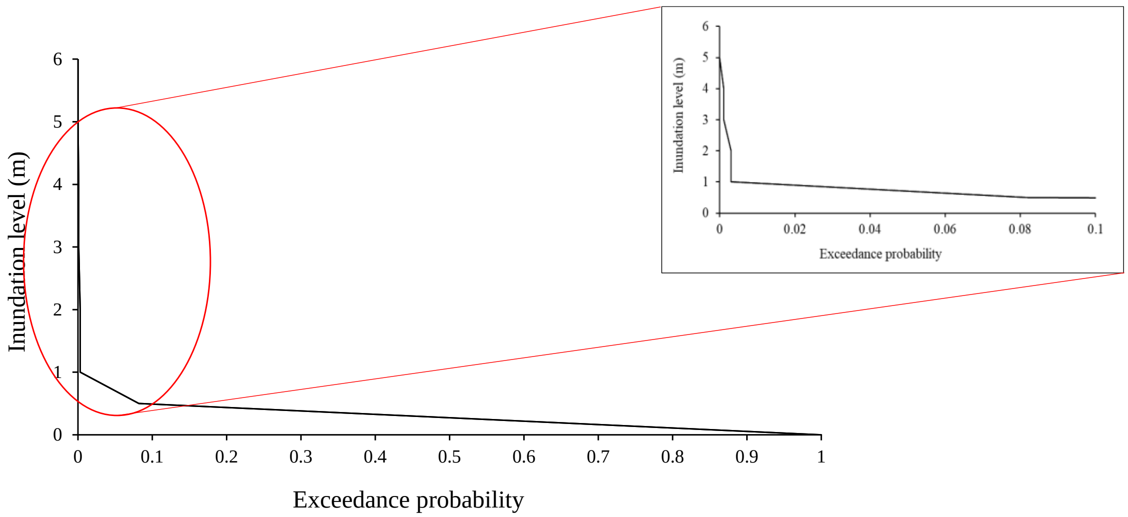


Figure 3.13 Exceedance probability-inundation level curve for Fethiye City Center

ii. Then inundation level-damage curve is constructed using the country-based depth-damage function and maximum damage values ($\frac{€}{m^2}$) in 2010 prices provided in Huizinga et al. (2017). The inundation level- damage curve for Fethiye City Center is given in Figure 3.14 as an example.

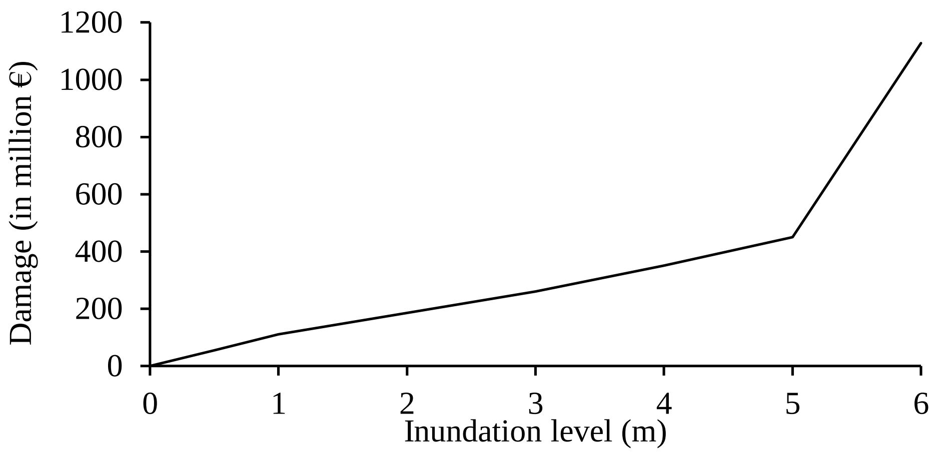


Figure 3.14 The damage-inundation level curve for Fethiye City Center

iii. Finally, the exceedance probability-damage curve is generated using the exceedance probability-inundation level and inundation level-damage curves. The exceedance probability-damage curve for Fethiye City Center is given in Figure 3.15.

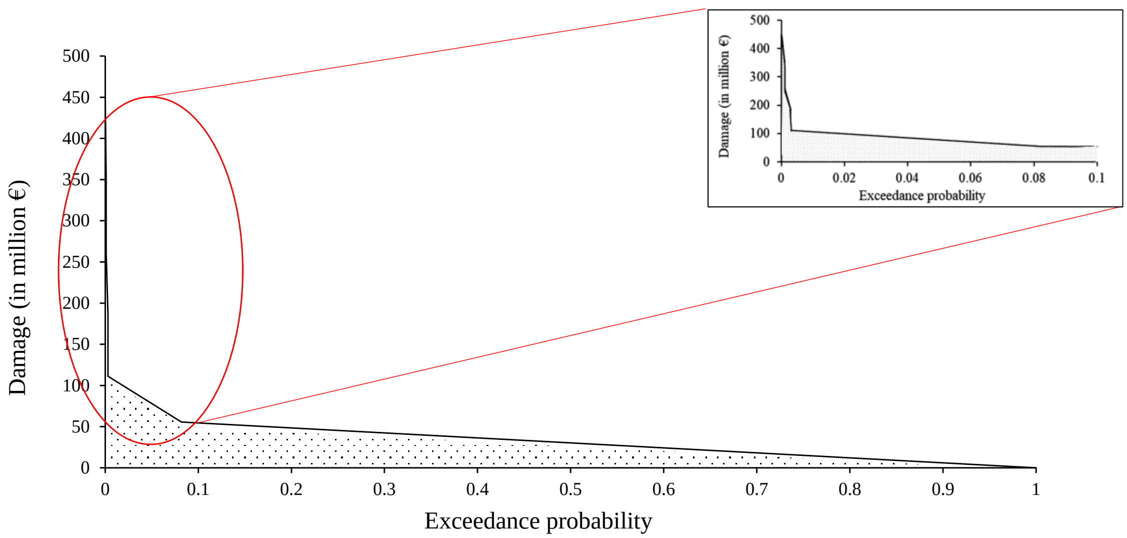


Figure 3.15 The exceedance probability-damage curve for Fethiye City Center

Finally, economic risk is calculated for each EaR by integrating the area under the exceedance probability-damage curve (DVWK 1985):

$$Risk_{Eco,EaR} = \sum \Delta P \overline{ED} \tag{3.14}$$

where $\Delta P = |P_j - P_{j-1}|$ is the probability of the interval between two exceedance probabilities j and $j-1$, and $\overline{ED} = \frac{1}{2}[ED_j + ED_{j-1}]$ is the mean economic damage corresponding to these two exceedance probabilities.

3.4.2.2 Social Risk Calculation

The same procedure that is used for the calculation of the economic risk is used for the calculation of the social risk. In the first stage, exceedance probability-inundation level curve is generated. However, this time exceedance probability corresponding to an inundation level of 0.5 m is set as the level that will result in a physical damage on people. Thus, the number of people exposed to minimum 0.5 m tsunami wave are considered as the number of physically damaged people for social risk calculations. The exceedance probability-inundation level curve for Fethiye City Center is given in Figure 3.16 as an example.

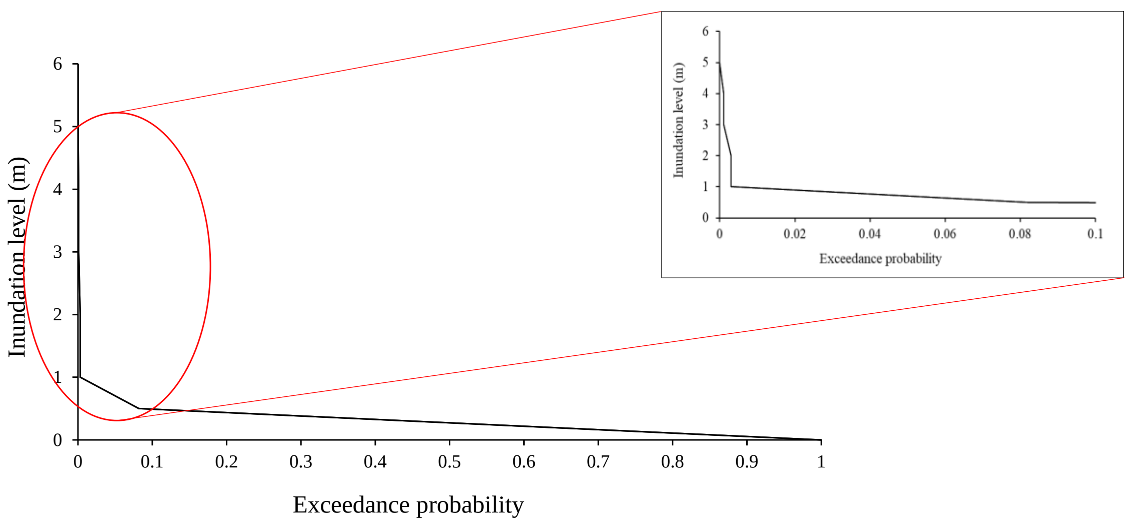


Figure 3.16 The exceedance probability-inundation level curve for Fethiye City Center

The damage for social risk is the multiplication of the number of physically damaged people, NP times the vulnerability coefficient as explained in Section 3.4.1.2. Since vulnerability coefficient is not a function of the inundation level, in the second stage number of physically damage people-inundation level curve is developed. The number of physically damage people-inundation level curve for Fethiye City Center is given in Figure 3.17 as an example.

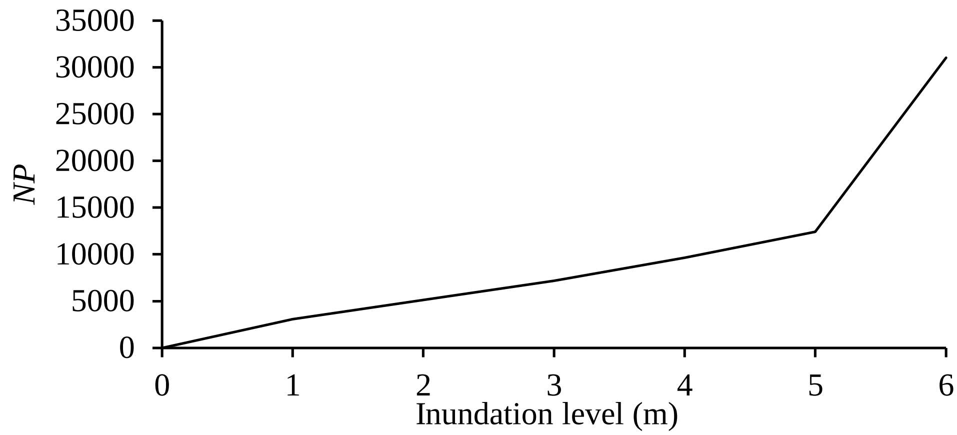


Figure 3.17 The number of physically damaged people-inundation level curve for Fethiye City Center

Finally, the exceedance probability-number of physically damaged people curve is generated using the exceedance probability-inundation level and number of physically damaged people-inundation level curves. The exceedance probability-number of physically damaged people for Fethiye City Center is given in Figure 3.18 as an example.

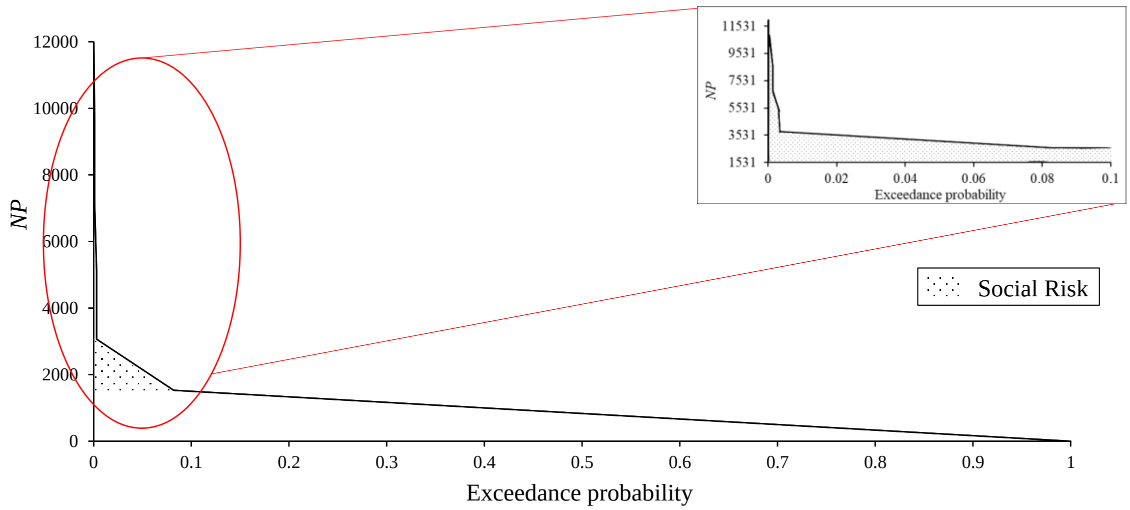


Figure 3.18 The exceedance probability-number of physically damaged people curve for Fethiye City Center

The social risk is calculated for each EaR by integrating the area under the exceedance probability-number of physically damaged people curve when the inundation level is greater than 0.5 m, which is set as the depth that will cause physical damage to a person.

$$Risk_{Soc,EaR} = if \begin{cases} i < 0.5\, m, & 0 \\ i \geq 0.5m, & \sum \Delta P \overline{SD} \end{cases} \tag{3.15}$$

where $\Delta P = |P_j - P_{j-1}|$ is the probability of the interval between two exceedance probabilities j and $j-1$, and $\overline{SD} = \frac{1}{2}[SD_j + SD_{j-1}]$ is the mean social damage corresponding to these two exceedance probabilities.

3.4.2.3 Environmental Risk Calculation

The calculation of the environmental risk is based on the binary approach. If inundation level reaches up to the altitude of the EaR, which is identified as an environmental hazard then environmental risk will be one. Otherwise, there will be no environmental risk:

$$Risk_{Env,EaR} = if \begin{cases} i < 0\ m, & 0 \\ i > 0\ m, & 1 \end{cases} \tag{3.16}$$

3.4.2.4 Overall Risk Calculation

In order to calculate an overall risk, first all dimensions of the risk are normalized to a range between 0 and 1. For example the economic risk for an EaR is normalized using the maximum economic risk calculated among all EaR. The normalization of the economic risk for the EaR is conducted as:

$$N\_Risk_{Eco,EaR} = \frac{Risk_{Eco,EaR}}{Risk_{Eco,max}} \tag{3.17}$$

where $N\_Risk_{Eco,EaR}$ is the normalized economic risk for EaR, $Risk_{Eco,EaR}$ is the calculated economic risk for EaR, $Risk_{Eco,max}$ is the maximum economic risk calculated among all the EaR in the study area.

The same procedure that is used to calculate normalized social risk for each EaR ($N\_Risk_{Soc,EaR}$) as well. Normalization is not necessary for the environmental risks since they are already calculated as zero or one (i.e. the binary approach). Normalized risk categories are aggregated to define an overall risk for each identified EaR in the study area. Three dimensions of risk are aggregated using different strategies:

i) to represent the worst case scenario, “OR” operator is used for the aggregation,
ii) to represent an equal importance scenario, equal weights are used for the aggregation, and
iii) to represent the case where the economic risk is dominating, it is weighted with 0.5 while the social and environmental risks are weighted with 0.25.

Here these three aggregation approaches are used to generate the overall risk map of the study area. However, other aggregation approaches can be implemented based on case specific requirements. The three aggregation strategies are explained below.

a) The Worst-Case Scenario

The “OR” operator is used to aggregate the three dimensions of risk. This type of aggregation presents the results of the worst-case scenario by assigning the maximum of the three risks as the overall risk:

$$Risk_{Worst-case} = max(N\_Risk_{\mathrm{Eco,EaR}}, N\_Risk_{Soc,EaR}, Risk_{Env,EaR}) \quad (3.18)$$

b) Equal Weighted Scenario

This scenario represents the case where each dimension is equally important thus weighted equally:

$$Risk_{Equal-weight} = \frac{1}{3}(N\_Risk_{\mathrm{Eco,EaR}} + N\_Risk_{Soc,EaR} + Risk_{Env,EaR}) \quad (3.19)$$

c) Economic Risk Dominated Scenario

When the decision-maker prefers to assign higher importance to the economic risk, the overall risk can be estimated using:

$$Risk_{Eco-weighted} = \frac{1}{4}\left(2N\_Risk_{\mathrm{Eco,EaR}} + N\_Risk_{Soc,EaR} + Risk_{Env,EaR}\right) \quad (3.20)$$

3.4.2.5 Overall Risk Maps

In order to present the spatial distribution of the economic, social, environmental and overall risks throughout the study area, the risk maps are generated. For better spatial representation, risk values are grouped into five categories. Color codes given in Table 3.8 is used in the risk maps.

Table 3.8 Risk categories

0.30≤	Extreme Risk	≤1.00
0.20≤	High Risk	<0.30
0.10≤	Medium Risk	<0.20
0<	Low Risk	<0.10
0=	No Risk	

3.5 Positioning of Tsunami Early Warning Systems

In this study, reduction in social risk dimension is used to select the best TEWS location among alternatives. Because, human survival is the first issue in the course of natural hazards (Haque and Etkin, 2007). Economic and Environmental risk dimensions are not taken into consideration in the scope of this study for positioning of TEWS. Positioning of TEWS is investigated considering both the whole study area (i.e. social risk in all seven countries) and individual countries. In other words, if one country decides to install a

TEWS what will be the best location for the device, or what will be the best location for a TEWS to maximize reduction of social risk in all seven countries (i.e. the whole study area). Country level social risk calculations given in Appendix-F may be a beneficial guide for positioning of TEWS in all seven countries.

There are a number of factors such as sufficient water depth and ship routes that restrict positioning of TEWS as explained in detail in Section 2.7. However, piracy activities, diplomatic obstacles between countries, and theft are not taken into consideration as TEWS positioning restrictions in the study area.

First, the study area is divided into 50 km x 50 km grids using ArcGIS. Then layers representing these two restrictions are overlaid on the map of the study area (see Figure 3.19). Red lines in Figure 3.19 show the major shipping routes and the green lines show the boundary where water depth is greater than 1000 m. Grids that satisfy these two restrictions are shown with pink polygons on Figure 3.19.

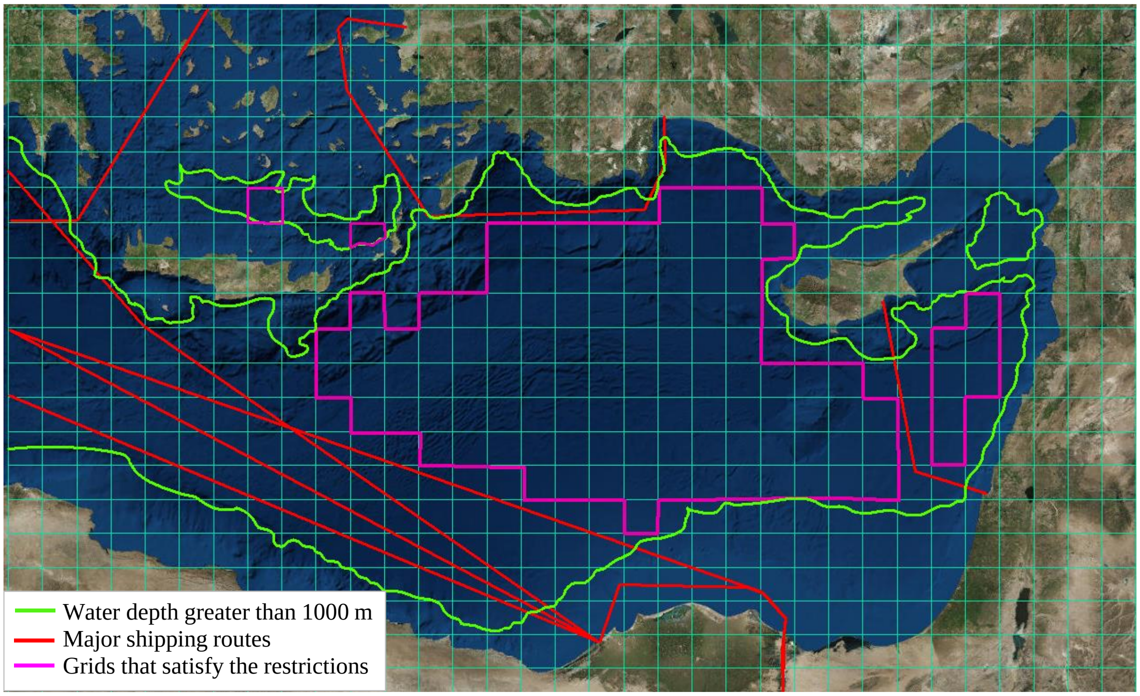


Figure 3.19 Potential TEWS positioning grids

When a tsunamigenic earthquake initiates, the TEWS detects tsunami wave and a signal is send to the tsunami early warning center which will release a tsunami warning for the people living in the coastline of Eastern Mediterranean. This way, people living along the coastline are informed before tsunami waves reach the shoreline. When there is enough time, people may move to safe altitudes and social risk (in this study assumed to be directly related to the number of physically damaged people from tsunami waves) will be reduced. Although there may be other means to reduce social risk, in this study, moving to safe altitudes on foot is assumed to be the only alternative to reduce the number of physically damaged people. Since high resolution data about man-made structures and high rise buildings is not available throughout the whole study area, high topographic areas are considered as safe altitudes in this study. Thus, people who have enough time to reach a safe altitude is assumed to be saved from physical damage from tsunami waves; thus contribute to the reduction of the social risk.

The aim is to select the best grid (i.e. within the pink polygons in Figure 3.19) to install the TEWS such that maximum reduction in social risk will be obtained in the study area. It is assumed in this study that the social risk is reduced by evacuating the people who are located in the inundated areas to safer altitudes. Since spatial distribution of the social risk is already calculated, a simple heuristic can be implemented to reduce the potential grids: the TEWS should be placed such that people at the high social risk areas have enough time to evacuate the inundated areas. In other words, the farther the TEWS from the high social risk areas the more time people at these areas will have to move to safer altitudes. Using this heuristic, first a set of potential TEWS locations are identified and then social risk reduction calculations are carried out for each one of these potential locations. Details of these calculations are explained in the following sections.

3.5.1 Required Time to Reach the Safe Altitude

Social risk without TEWS is already calculated for each EaR using the procedure explained in Section 3.4.2.2. Now, social risk with TEWS (i.e. when a TEWS is installed) need to be calculated in order to estimate the reduction in social risk.

When the tsunami warning is released, the most important thing is to reach a safe altitude as soon as possible. Therefore, determination of the minimum distance to the safe altitude, required time to reach that location, and remaining time to move to the safe altitude after the tsunami warning are vital for the people living in the risky areas. In order to reach a safe altitude, commonly **on foot** is considered as the reliable alternative. Because, roads might be either damaged due to the earthquake or jammed due to traffic (Atwater, 1999).

For this reason, it is assumed that the only evacuation method after the tsunami warning is on foot. So, other evacuation methods are not considered in this study.

Distances to the safe altitudes for each element at social risk (from hereafter EaR which has a social risk is referred to as element at social risk) are determined using inundation depth distribution at that EaR obtained from MC simulations and the topography. Calculation procedure of maximum inundation depths for each EaR is explained in detail in Section 3.3.3.1. People who have enough time to reach an altitude higher than the maximum inundation depths will be saved (i.e. the social risk for those people will reduce to zero). As an example, if a maximum inundation depth of 1 m is recorded at Cairo Agricultural Area based on MC simulations then the people who have enough time to walk to safe altitudes (i.e. 1 m) will not be physically damaged. Hence, first the distance to the nearest safe altitude should be determined. Distance to the safe altitude directly dependent on the topography of the EaR and its surrounding. For instance, minimum distance to the safe altitude for Cairo Agricultural Area may reach up to 15 km due to the fact that Cairo Agricultural Area is surrounded by low lands below sea level. Therefore, the people who wants to escape from tsunami waves in Cairo Agricultural Area has to walk approximately 15 km to reach the safe altitude (see Figure 3.20). A-A cross section is given in Figure 3.20 to demonstrate the topography (see Figure 3.20(b)). In this study, Google Earth application is used to identify safe altitudes for all elements at social risk.

Figure 3.20 Altitude and distance from the coast (Retrieved from https://www.google.com.tr/intl/tr/earth/)

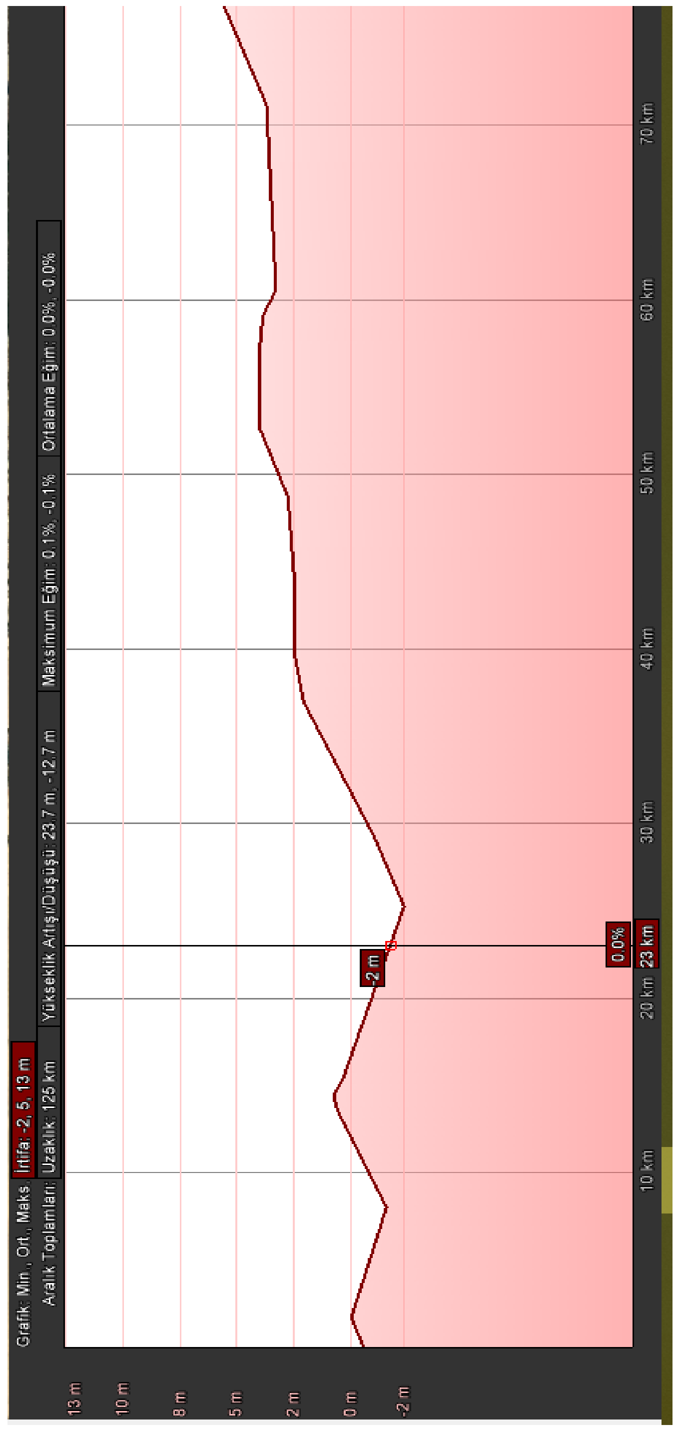


Figure 3.20 (b) Topography of the A-A cross section (Retrieved from https://www.google.com.tr/intl/tr/earth/)

After identifying the distance to the safe altitude, required time to reach this altitude has to be determined. In the literature, it is stated that a healthy adult can walk around 5 km per hour (Enright and Sherrill, 1998). Therefore, required time to reach the safe altitude is calculated using the following formula:

$$t_R = \frac{X_s}{X_{max}} 60 \tag{3.21}$$

where t_R is the required time (in minutes) to reach the safe altitude, X_s is the distance to the safe altitude, and X_{max} is the maximum distance a healthy adult can walk within 60 minutes which is taken as 5 km/hr in this study.

Estimated time of tsunami wave arrivals (ETAs) is one of NAMI-DANCE outputs as explained in Section 3.3.3 and it is recorded for all the MC simulations conducted during the risk assessment study. The remaining time to move to the safe altitude for each EaR after tsunami warning is released, t_A is calculated using the following formula:

$$t_A = ETA_{from\_source\_to\_EaR} - ETA_{from\_source\_to\_TEWS} \tag{3.22}$$

where $ETA_{from\_source\_to\_EaR}$ is the estimated time of tsunami wave arrival from source to EaR and $ETA_{from\_source\_to\_TEWS}$ is the estimated time of tsunami wave arrival from source to TEWS.

3.5.2 Social Risk Reduction by means of Tsunami Early Warning System

The social risk is calculated for two different conditions: without and with TEWS. Social risk reduction with the implementation of TEWS is calculated as follows:

$$\Delta R = N\_Risk_{Soc,EaR} - N\_Risk_{Soc,EaR\_with\_TEWS} \tag{3.22}$$

where ΔR is the risk reduction amount. $N\_Risk_{Soc,EaR}$ and $N\_Risk_{Soc,EaR\_with\_TEWS}$ are the amount of normalized social risk without and with TEWS, respectively. The normalized social risk with TEWS is calculated using:

$$N\_Risk_{Soc,EaR\_with\_TEWS} = N\_Risk_{Soc,EaR} - C_R N\_Risk_{Soc,EaR} \tag{3.23}$$

where C_R is the risk coefficient calculated using the required time to reach the safe altitude (t_R) and remaining time to move to safe altitude after tsunami warning (t_A). If the required time to reach the safe altitude is smaller than the remaining time to move to safe altitude after tsunami warning is released, it is assumed that the social risk for the EaR becomes zero. On the contrary, if the required time to reach the safe altitude is greater than the remaining time to move to safe altitude after tsunami warning, social risk reduces proportional to the amount of time available to move to a safe altitude. Correspondingly, risk coefficient, C_R, is calculated as:

$$C_R = if \begin{cases} t_R < t_A, & 1 \\ t_R > t_A, & \dfrac{t_A}{t_R} \end{cases} \tag{3.24}$$

where t_R is the required time to reach the safe altitude, and t_A is the remaining time to move to safe altitude after tsunami warning. C_R allows a proportional (in term so available time) number of people to reach to a safe altitude.

4 RESULTS AND DISCUSSIONS

To assess economic, social, environmental risks at the Eastern Mediterranean, 91 EaR are identified from the coastlines of seven countries based on land use (i.e. residential, industrial, and agricultural), population size, and environmental significance. Economic, social and environmental risks are calculated using Monte Carlo simulations and aggregated into an overall risk. Then, based on reduction in social risk, the best buoy location is identified among a set of potential locations. The results are provided in this chapter.

4.1 Monte Carlo Simulation Results

Earthquake source parameters used in this study are randomly generated using MC simulations. 523 historical earthquakes from 1900 to 2013 are used to generate TEDS using the catalogue compiled in EU funded TRANSFER project. The earthquake source parameters of the historical earthquakes are given in Appendix-A. TEDS is composed of 523 historical earthquakes gathered from the TRANSFER project (see Figure 3.4). To generate earthquakes within the MC loop, first 1000 earthquakes are randomly sampled from TEDS. The locations of these 1000 sampled earthquakes are shown with red stars in Figure 4.1. The size of the symbols is proportional to the number of earthquakes sampled from that location.

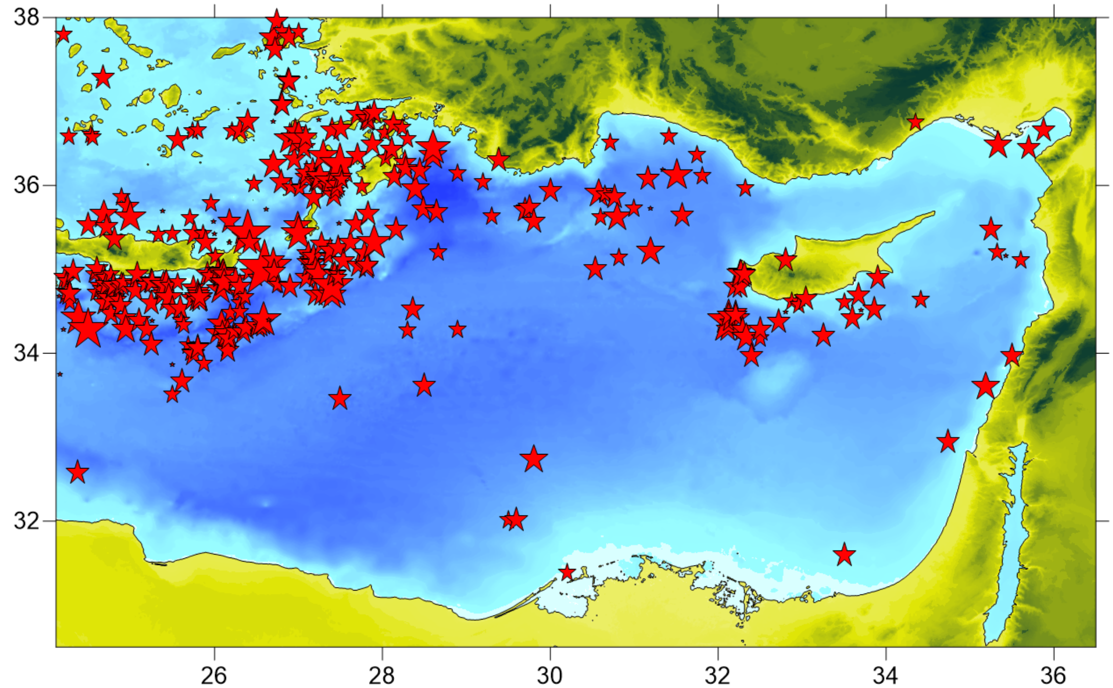


Figure 4.1 Locations of the sampled earthquakes

Then earthquake source parameter values for each of these 1000 earthquakes are assigned following the procedure explained in Table 3.3. Since M_w and $Focal\,depth$ are the independent parameters, they are sampled from their PDFs that are assigned using M_w's and $Focal\ depth$'s of the earthquakes found in TEDS. Comparison of histograms of M_w and $Focal\,depth$ of TEDS, the fitted distributions to these data and the histogram of randomly generated 1000 data for M_w and $Focal\ depth$ are demonstrated in Figure 4.2 and Figure 4.3, respectively.

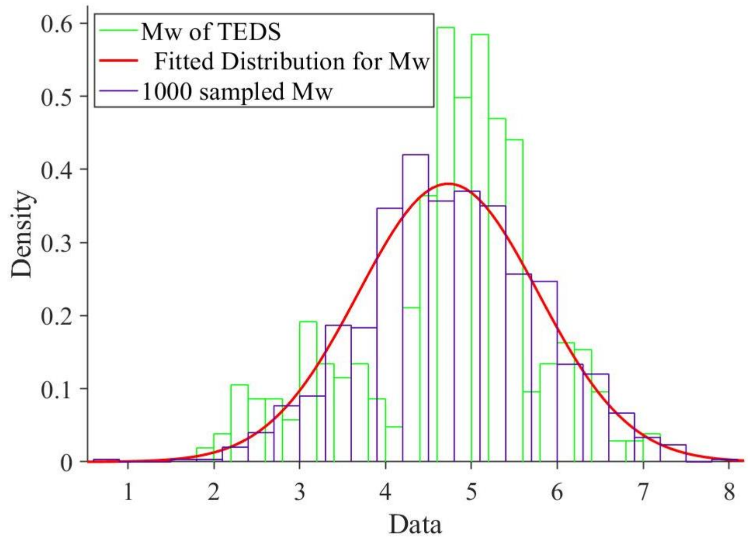


Figure 4.2 Histogram of M_w of TEDS, its assigned Normal Distribution and the histogram of randomly generated 1000 M_w's from the Normal Distribution

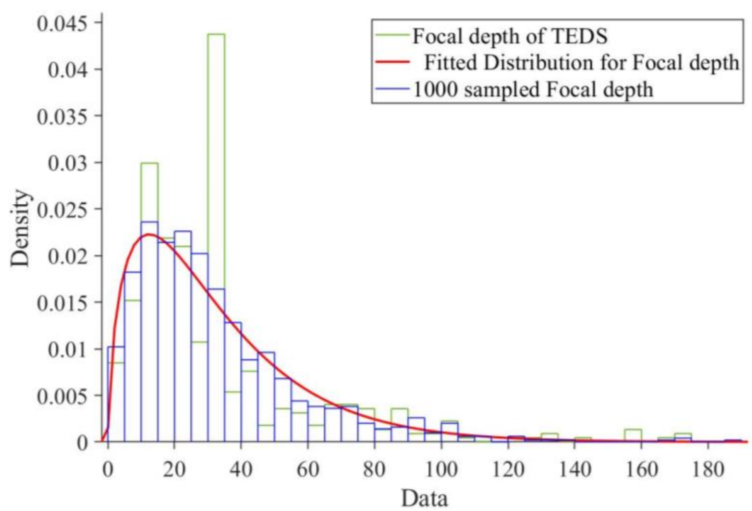


Figure 4.3 Histogram of $Focal\ depth$ of TEDS, its assigned Gamma Distribution and the histogram of randomly generated 1000 $Focal\ depth$'s from the Gamma Distribution

Among 1000 randomly generated earthquakes, the random earthquake with the largest M_w of 8.0 is located on Hellenic Arc near Crete Island and has a $Focal\ depth$ of 11 km. The maximum M_w of TEDS is 7.2; it is located on the Hellenic Arc close to Rhodes Island and has a $Focal\ depth$ of 1 km. Locations and earthquake source parameters of TEDS and 1000 randomly generated earthquakes for MC simulations are given in Appendix-B.

As can be seen from Figure 4.2, the performance of the Normal Distributions around M_w values of 5 is not very good. However, earthquakes with high M_w generally cause large tsunami waves and large inundations at EaR, which directly affects the risk. Thus, proper representation of the right tail of the M_w histogram of TEDS is more crucial and as can be seen from Figure 4.2, the Normal Distribution seems to represent these earthquakes with high moment magnitudes properly. As stated previously, the highest M_w value within the TEDS is 7.2, while as a result of 1000 MC simulation 10 M_w values that are higher than 7.2 is sampled. Therefore, we believe that reasonable moment magnitudes are sampled from the Normal Distribution for risk calculations.

4.2 Risk Assessment

Risk assessment results of each dimension is provided separately first. Then the overall risk results and corresponding maps are given.

4.2.1 Economic Risk Assessment

Economic risk is calculated for EaR for different damage classes as summarized in Table 4.1. Within the study area, economic risks are calculated for 41 residential buildings, 29 industrial facilities, and 5 agricultural regions. As given in Equation (3.9), economic damage is estimated using the inundation depth and the inundated area. Inundated area of each EaR for different inundation depths are calculated using digital elevation maps (DEM) with 30m x 30m grid size. DEMs are retrieved from Shuttle Radar Topography Mission (SRTM) (Web 4.1).

Table 4.1 EaR at economic risk dimension

Risk Dimension	Damage Class	Elements at Risk
Economic Risk Dimension	Residential buildings	City centers, summer villages
	Industrial facilities	Airports, ports and marinas, factories, industrial zones
	Agricultural regions	Agricultural areas

Statistical summary of economic risks calculated for 91 EaR is provided in Table 4.2 and the box-whisker plot of the economic risk is given in Figure 4.4. Since most of the economic risks are either zero or very close to zero, only the outliers can easily be seen from the box-whisker plot; thus a zoomed plot to the economic risk range of 0 and 0.16 is also provided in Figure 4.4. As can be seen from Figure 4.4, although the mean value of economic risk is 0.07, economic risks larger than 0.03 are classified as outliers. There are 16 EaR which resulted in economic risks that are larger than 0.03. The maximum economic risk is 1.62 and calculated at Cairo Agricultural Area, which is followed by 1.21 at Alexandria City Center. The third largest economic risk is 0.89 and occurred at Fethiye City Center.

Table 4.2 Statistical summary of economic risk for 91 EaR

Statistics	Economic Risk
Minimum	0
Mean	0.07
Median	0.00004
Maximum	1.62

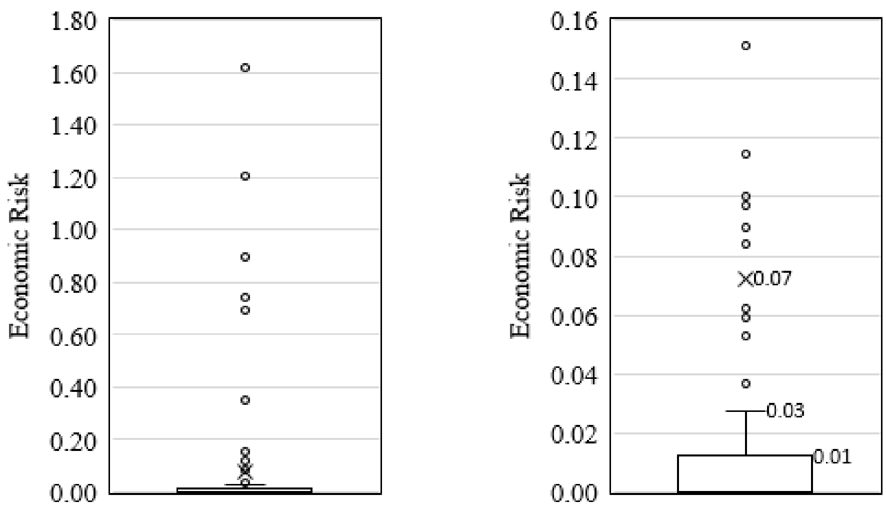


Figure 4.4 Box-whisker plot of economic risk. Zoomed box-whisker plot of economic risk is provided on the right.

In order to adjust economic risk between zero and one, economic risk values are normalized with respect to the maximum risk (i.e. 1.62). Normalized economic risk map of the study area is given in Figure 4.5. Since the study area is too big to demonstrate all EaR in detail, economic risk maps of each country found in the study area is prepared and given in the following paragraphs. Moreover, economic risk maps of a number of selected EaR are presented as well.

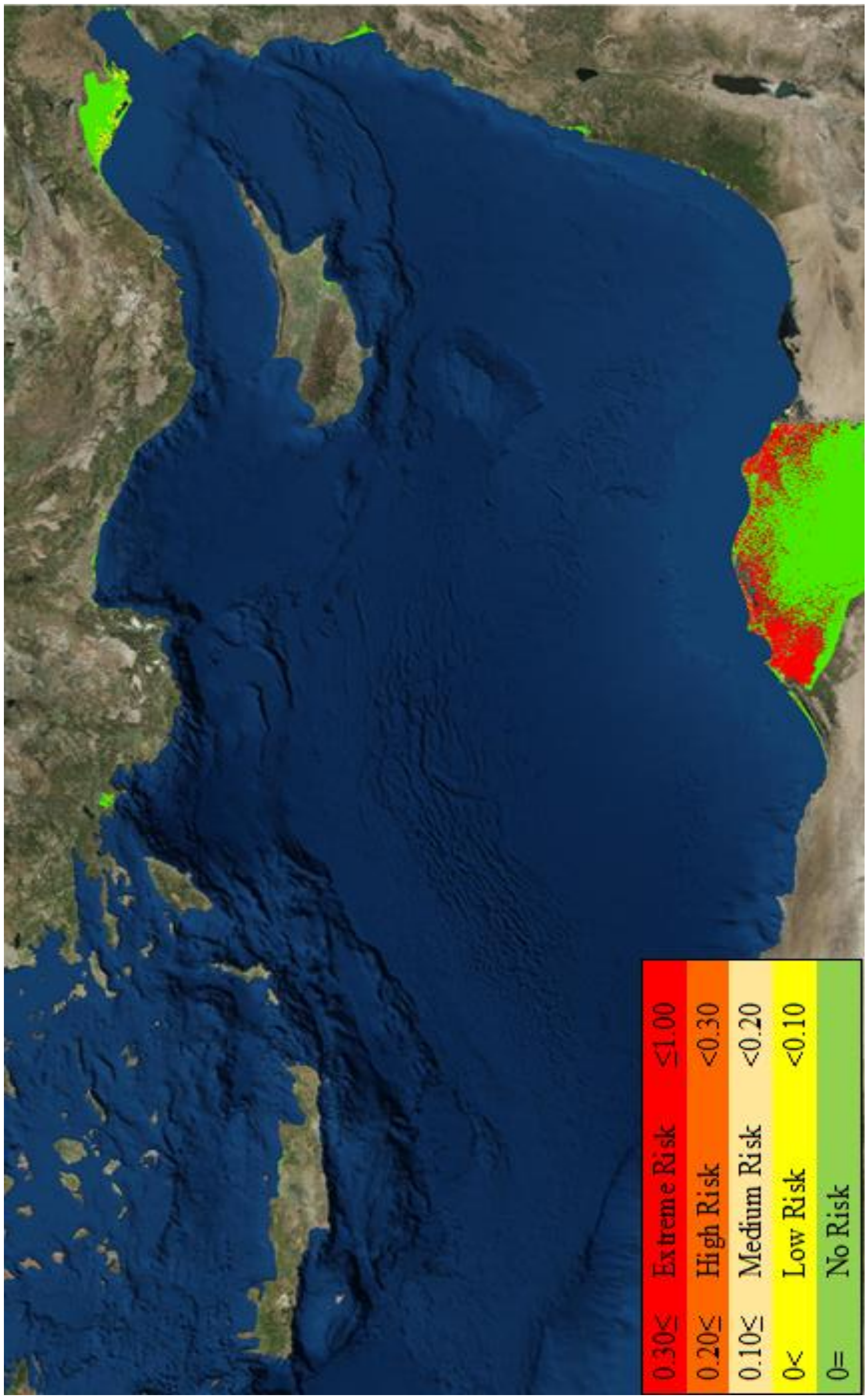


Figure 4.5 Normalized economic risk map of the study area

In this study, it is assumed that a tsunami wave of height h meters at the coast will inundate all the land that is below h meter altitude. Such an assumption is used since it is not possible to obtain high resolution maps for all EaR to carry out 2-dimensional flood analysis. This assumption represents a worst-case scenario since some of the land that is below h meter altitude will not be inundated if it is not connected with the sea. This assumption introduces some error to economic damage estimates, thus economic damage values obtained in this study should be used with caution. Relative risks provide more realistic comparisons among EaR.

To investigate the error introduced by this assumption, a simple analysis is conducted. First, a hypothetical example is provided to explain the consequence of this assumption. Let’s assume a tsunami wave height of 5 m is observed at the coastline of Fethiye. Areas at the Fethiye city center having altitudes up to 5 m is assumed to be inundated and the inundation level within this area is assumed to be 5 m. The map showing all the inundated areas at Fethiye city center is given in Figure 4.6. Due to the assumption, some spots that do not have any connection with the coast are assumed to be inundated. Some example grids are marked with red circles in Figure 4.6. Since these spots which have altitudes less than 5 m are surrounded by higher land, they should not be inundated. However, due to the assumption these grids are incorrectly marked as inundated areas. This introduces some error to economic and social damage calculations.

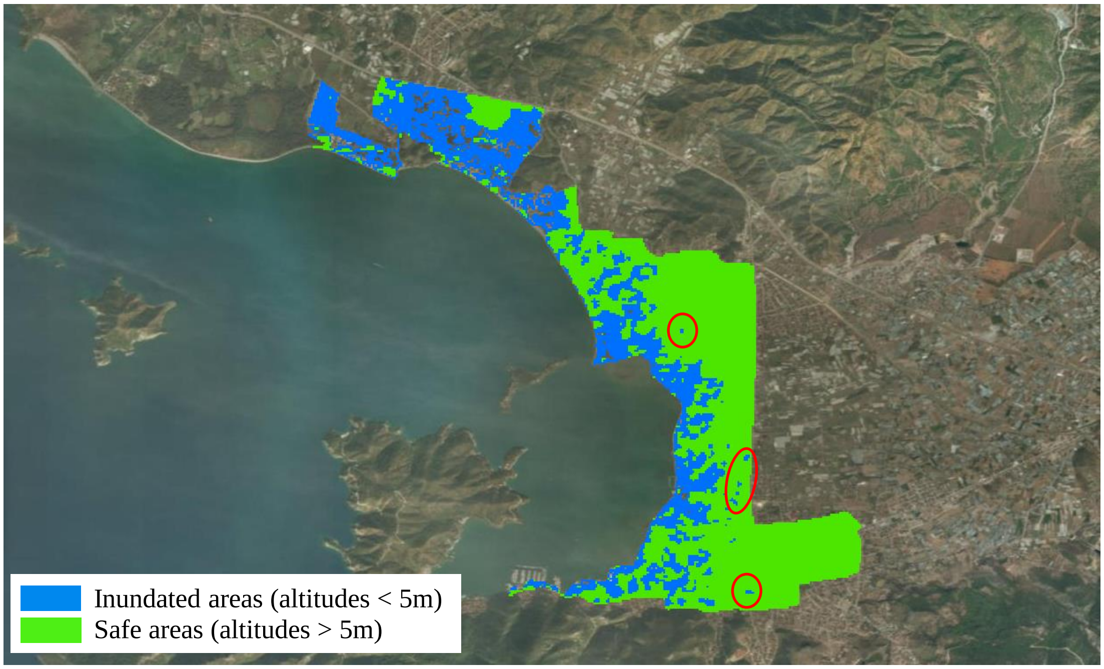


Figure 4.6 Inundated and safe areas at Fethiye city center when a tsunami with 5 m wave height is observed at the coastline. Red circles represent some grids that are incorrectly considered to be inundated due to our assumption.

To investigate the amount of error that is introduced into the results due to this assumption, some of the EaR having inundated areas that are not connected to the sea are analyzed in detail. For this purpose, Fethiye, Finike and Port Said City Centers and Dalaman Airport are examined (see Figure 4.7). In Figure 4.7, red and yellow colors show the inundated grids that are connected to the sea. Black color represents the grids assumed to be inundated although not connected to the sea. In other words, these are the cells that area classified as inundated incorrectly due to our assumption.

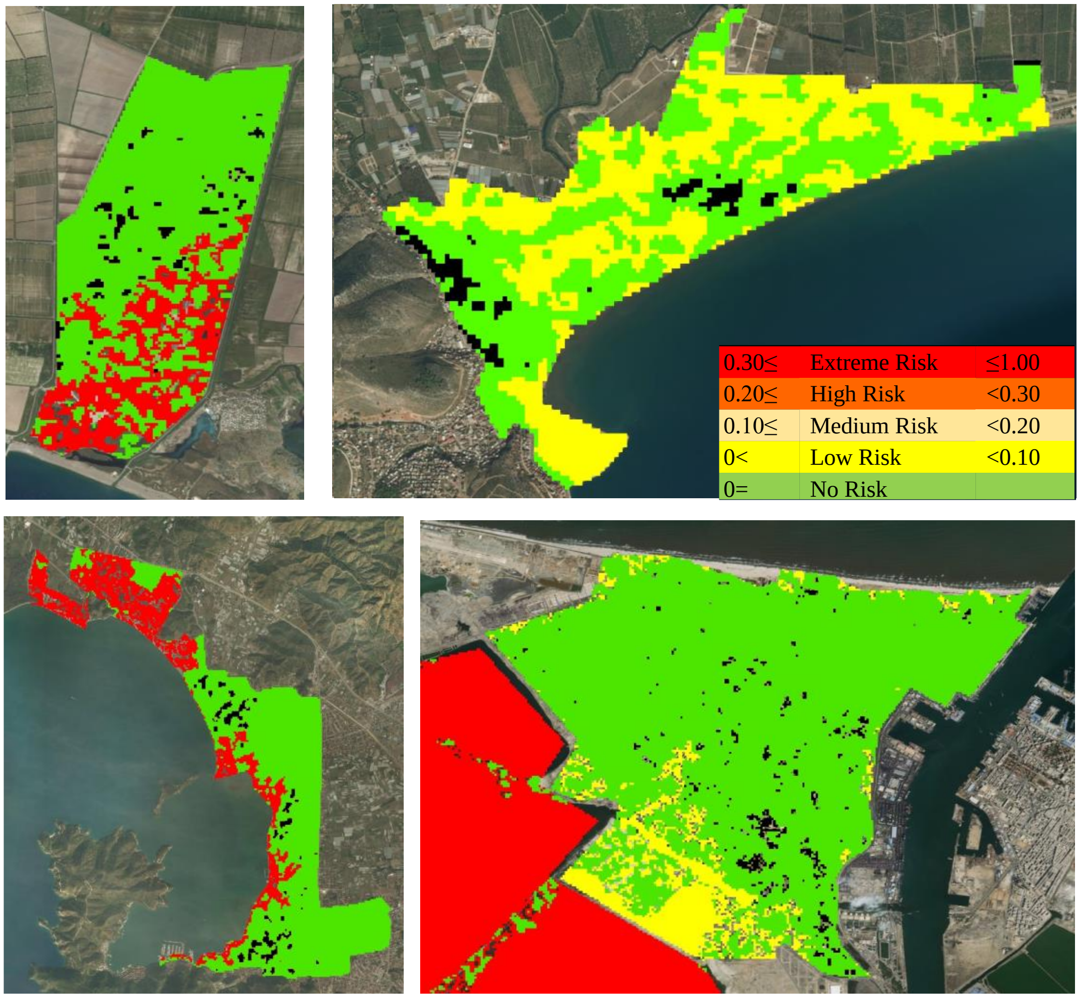


Figure 4.7 Examined EaR to evaluate the reliability of the assumption for Dalaman Airport (top left), Finike City Center (top right), Fethiye City Center (bottom left) and Port Said City Center (bottom right)

The number of correctly and incorrectly inundated grids for these EaR are calculated and error due to this incorrect classification is quantified. Then, normalized economic risk values with and without this assumption are calculated as well. The results are shown in Table 4.3. This results show that the error due to the assumption is between 2% to 6% for the selected EaR. The results provided in this study should be evaluated considering this range of error. In terms of economic risk calculations, since the assumption results in higher risks, it represents a worst-case scenario. This error can be removed if detailed topographic maps of all EaR are obtained and inundated areas are calculated using 2-dimensional hydraulic models. However, we believe that comparative evaluation of the current results for selected 91 EaR provide valuable risk assessment and management information. In the following, we provide economic risk analysis for each of the seven countries found in the study area.

Table 4.3 Evaluation of the effect of the assumption on normalized economic risk values

EaR	The number of all inundated grids	The number of inundated grids that are not connected to the sea	Error	Normalized economic risk with assumption	Normalized economic risk value without assumption
Fethiye City Center	3372	206	0.06	0.55	0.52
Finike City Center	1559	109	0.07	0.09	0.08
Port Said City center	3166	411	0.11	0.04	0.04
Dalaman Airport	2243	89	0.04	0.46	0.44

Normalized economic risk map for Cyprus is given in Figure 4.8. Gazimagusa City Center and Paphos International Airport have NO economic risk whereas coastal parts of Larnaca City Center have LOW economic risk. Normalized economic risk maps of these three EaR are given in Figure 4.8 as well. It can be concluded that Gazimagusa City Center located at the south-eastern part of Cyprus Island stays secure from tsunamigenic earthquakes generated in Hellenic Arc which is the main source of the earthquakes generated in the Eastern Mediterranean. On the other hand, Paphos International Airport also seems secure due to having a small-inundated area compared to that of the riskiest element in the study area. According to MC simulations, a maximum tsunami wave of 1 m hits Larnaca City Center and certain parts of the city are inundated. This resulted in LOW economic damage and LOW economic risk.

Figure 4.8 Normalized economic risk maps for Gazimagusa City Center (top right), Paphos International Airport (bottom left) and Larnaca City Center (bottom right) in Cyprus

Most of the EaR having EXTREME risks are observed in Egypt due to its large and lowlands such as Cairo Agricultural Area and Alexandria City Center. The largest economic risk among all 91 EaR is calculated for Cairo Agricultural Area due to its large size with high agricultural value. When inundated, the large agricultural land results in large economic damage and correspondingly in EXTREME economic risk.

Normalized economic risk maps for Mersa Matruh City Center and Port Said City Center are given in Figure 4.9. As can be seen from the normalized economic risk map of Port Said City Center, there is LOW risk at the coast and there is a NO risk zone next to it. Further inland, there is another LOW risk zone. This is due to the lowlands behind the city center. According to the topography, the middle section of Port Said City Center is not inundated while further inland there is inundation, and consequently economic risk. A similar situation is observed at Mersa Matruh City Center and Alexandria City Center as well. Some of parts of Alexandria City Center lies at -10 meter elevation.

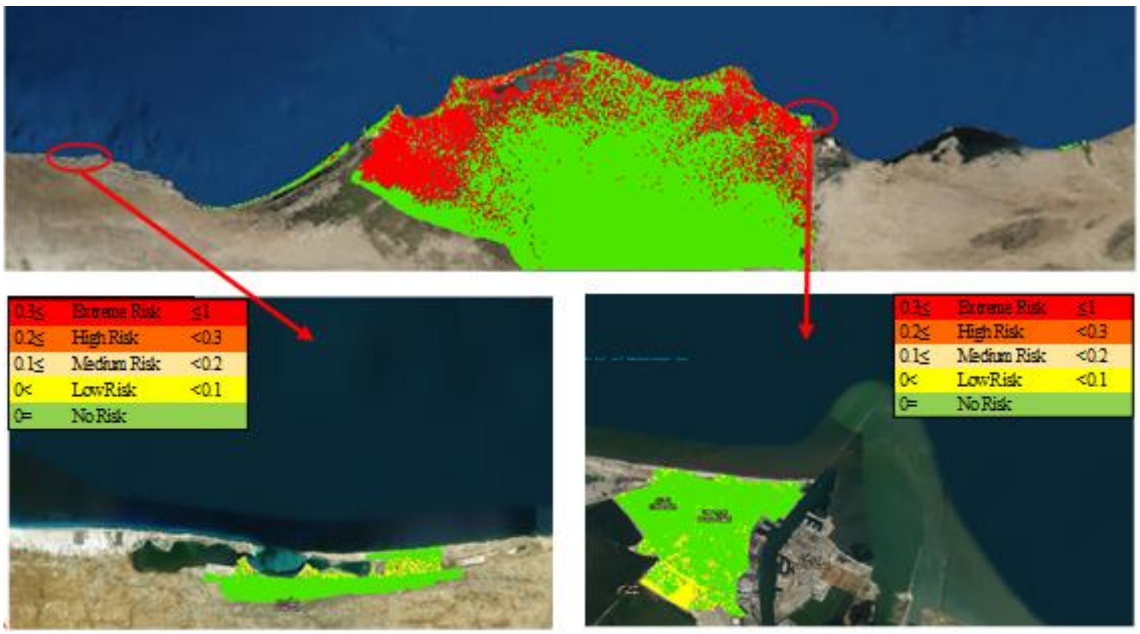


Figure 4.9 Normalized economic risk maps for Mersa Matruh City Center (bottom left) and Port Said City Center (bottom right) in Egypt

Since the study area only covers Eastern Mediterranean Sea, Crete Island is the only place considered for risk assessment in Greece. Crete Island is located on the Hellenic Arc, which is the most seismically active fault in the Mediterranean Sea. Therefore, Heraklion City Center and Crete Summer Villages have HIGH and EXTREME economic risk, respectively. Normalized economic risk maps of these two EaR are demonstrated in Figure 4.10.

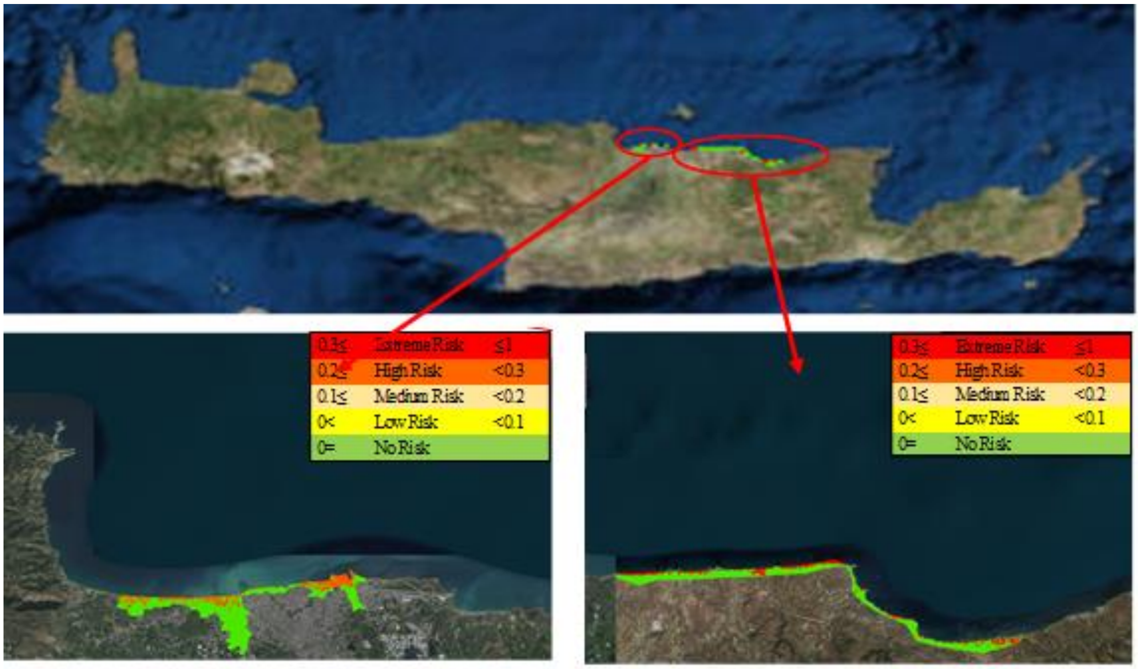


Figure 4.10 Normalized economic risk maps for Heraklion City Center (bottom left) and Crete Summer Villages (bottom right) in Greece

Haifa, Nahariya and Tel-Aviv City Centers, Haifa and Ashdod ports, Ashkelon Seawater desalination plant, Haifa Airport and Herzliya Marina are taken into consideration in terms of economic risk dimension in Israel. Normalized economic risk maps for Nahariya City Center, Ashdod Port and Tel-Aviv City Center are given in Figure 4.11. While Tel-Aviv City Center, Haifa Airport and Herzliya Marina have NO economic risk, the rest of the elements have LOW economic risks.

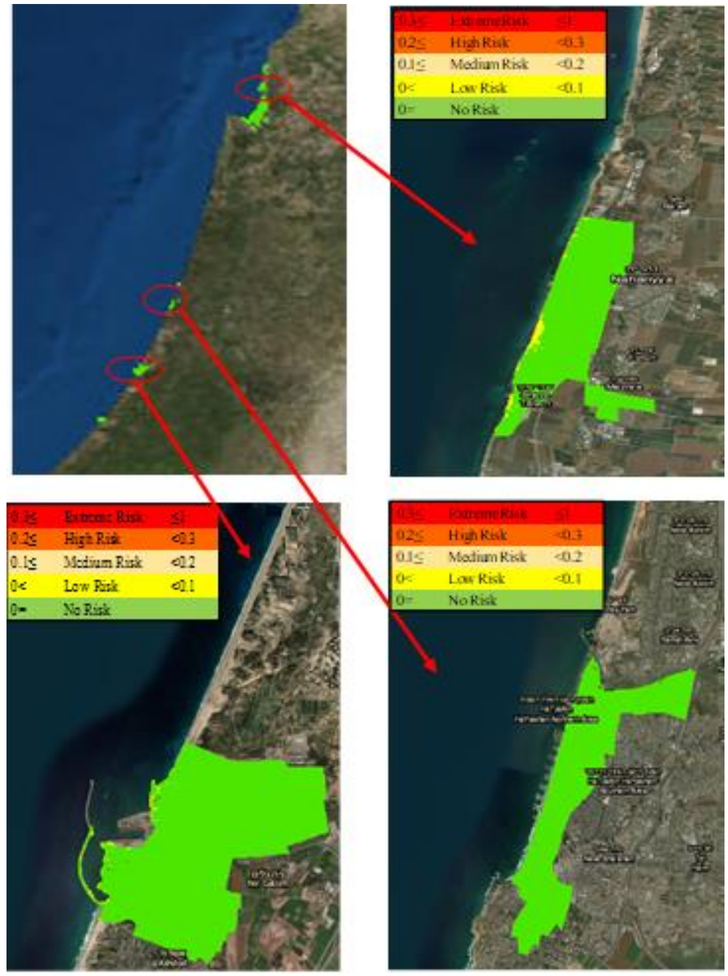


Figure 4.11 Normalized economic risk maps for Nahariya City Center (top right), Ashdod Port (bottom left) and Tel-Aviv City Center (bottom right) in Israel

Normalized economic risk map for Lebanon is given in Figure 4.12. Batraun, Beirut and Tripoli City Centers, Beirut and Tripoli ports, Beirut International Airport, Koubba Industrial Zone and Marina Dbayeh are considered as the elements at economic risk in Lebanon. However, none of the elements is inundated in this country according to tsunami simulations. This is because all EaR in Lebanon are located high enough above the sea level so that they are not effected from tsunami waves. Another reason for LOW risks in Lebanon might be Cyprus Island acting like a breakwater for Lebanon coasts against tsunami waves generated at the Hellenic Arc. Normalized economic risk maps for Tripoli City Center, Beirut Hariri International Airport and Beirut City Center are given in Figure 4.12.

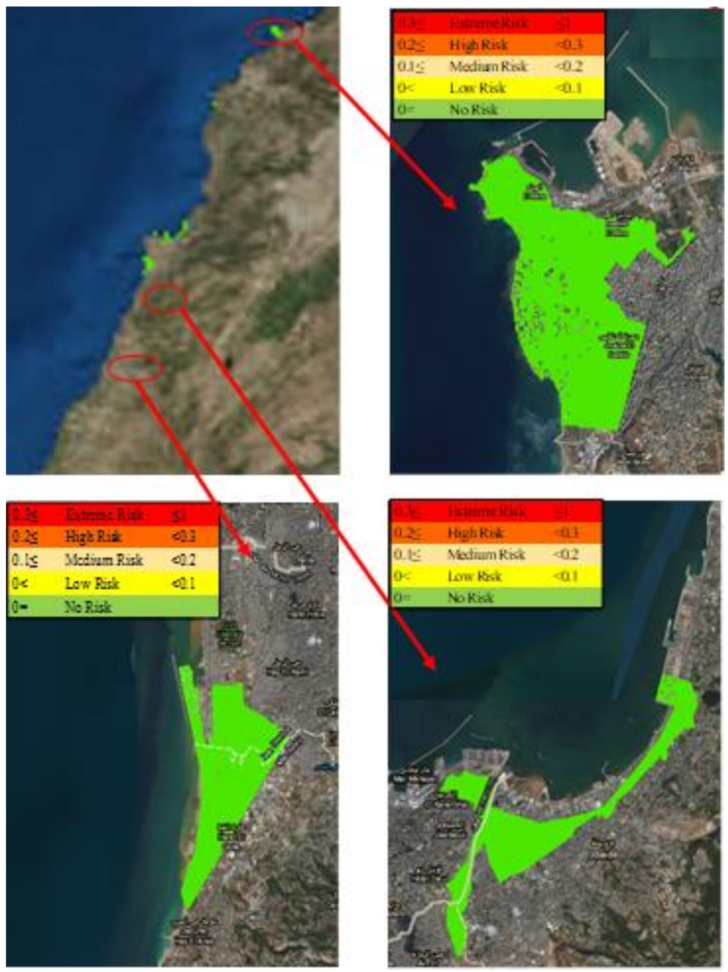


Figure 4.12 Normalized economic risk maps for Tripoli City Center (top right), Beirut Hariri International Airport (bottom left) and Beirut City Center (bottom right) in Lebanon

Similar situation to what is observed in Lebanon is valid for Syrian coasts. As can be seen in Figure 4.13, there is no economically risky element in Syria. One reason might be again Cyprus Island acting like a breakwater for the coasts of Syria. The other reason might be the low number of earthquakes generated along this region (see Figure 4.1). Normalized economic risk maps for Latakia City Center, Tartus City Center and Tartus Agricultural Area are given in Figure 4.13.

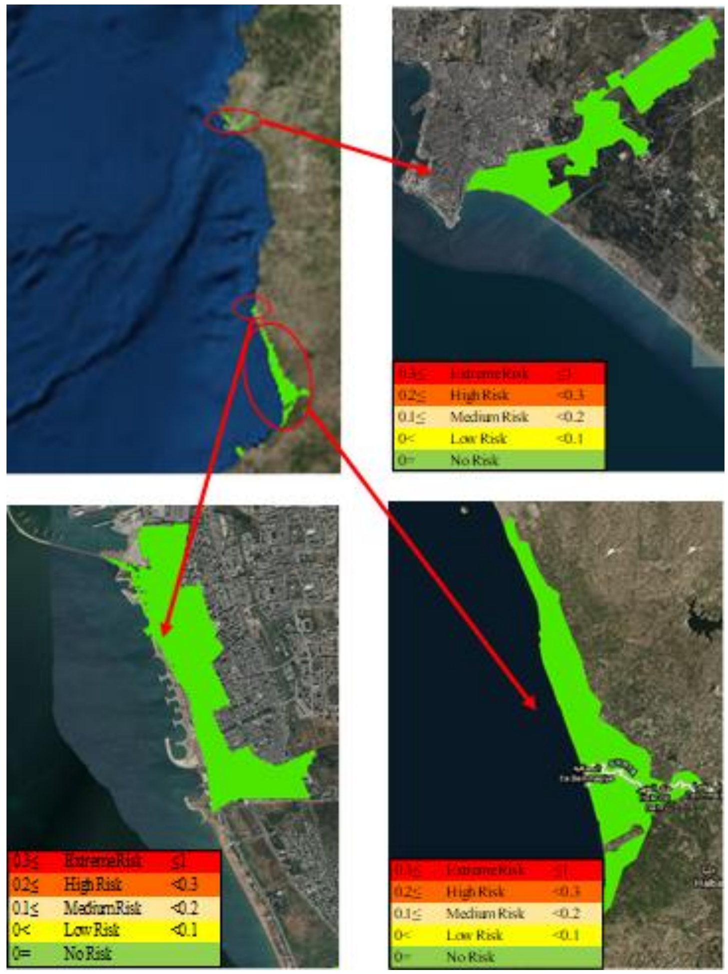


Figure 4.13 Normalized economic risk maps for Latakia City Center (top right), Tartus City Center (bottom left) and Tartus Agricultural Area (bottom right) in Syria

Normalized economic risk map for southern coasts of Turkey is given in Figure 4.14. Turkey has the longest coastline and the most densely populated country in the Eastern Mediterranean compared to the other countries located in the region (see Table 3.1). Hence, 41 EaR are identified from Turkish coastlines and 33 of them are used in economic risk calculations. 8 EaR are identified as environmental hazards and used in environmental risk calculations. According to the economic risk calculations, 21 elements assessed under economic risk have NO risk, 10 elements have LOW risk and 2 elements have EXTREME risk in Turkey. Fethiye City Center and Dalaman Airport have EXTREME risk because of high tsunami waves reaching up to 4 m hitting the coasts of these two EaR several times in the MC simulations. It can be also concluded that the eastern coasts of Turkey are less vulnerable than the western parts because of the positive effect of Cyprus Island acting like a breakwater against the tsunami waves coming from Hellenic Arc. Normalized economic risk maps for Dalaman Airport, Fethiye City Center and Iskenderun City Center are given in Figure 4.14.

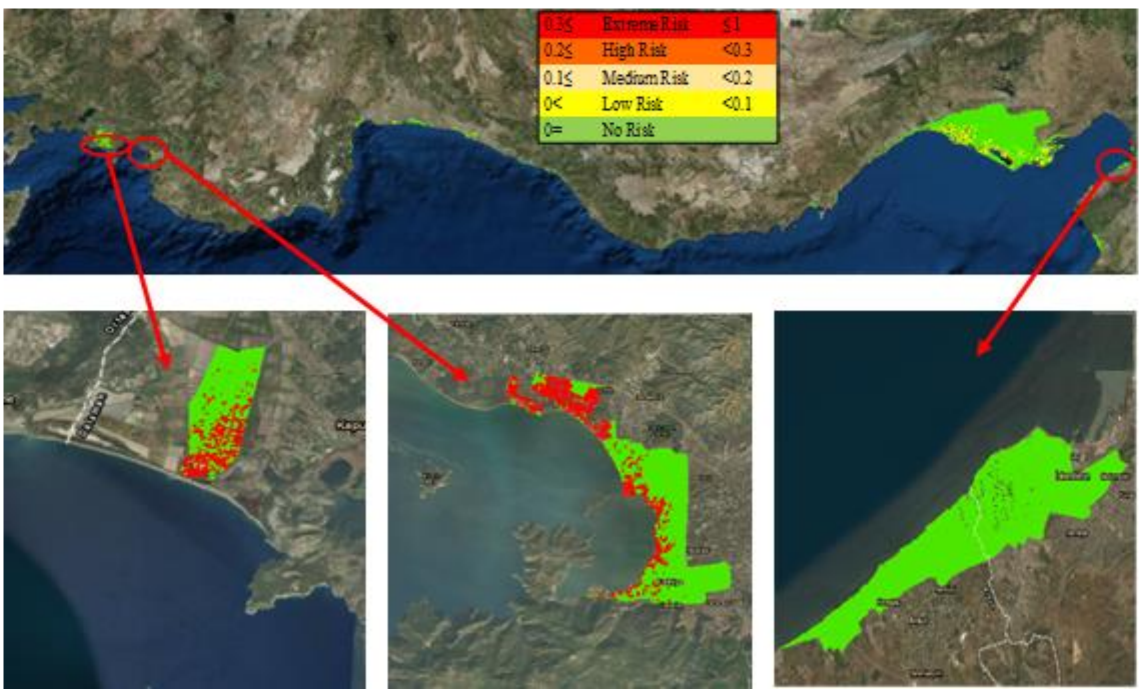


Figure 4.14 Normalized economic risk maps for Dalaman Airport (bottom left), Fethiye City Center (bottom middle) and Iskenderun City Center (bottom right) in Turkey

Economic risk is calculated for all EaR. Information sheets containing inundation levels versus affected area and economic damage for each of these EaR are given in Appendix-D. Tsunami wave height frequency plots and tsunami risk map for the worst case scenario (see Equation (3.18)) are also provided in Appendix-D.

4.2.2 Social Risk Assessment

Number of physically damaged people is considered as the consequence for social risk calculations. Since there is people at all EaR, social risk assessment is conducted for all identified EaR in the study area. The number of people found in the area where inundation exceeds 0.5 m (see Equation (3.15)) is calculated by multiplying the population density and the inundated area of the related EaR. Name, location, country, approximate area, population density and evaluated risk dimension of each EaR is given in Table 3.2 at Section 3.

Statistical summary of social risks calculated for 91 EaR is also provided in Table 4.4 and the box-whisker plot of the social risk is given in Figure 4.15. Since the social risks are very low compared to the social risk value of Cairo Agricultural Area, only two of the outliers can be seen from the box-whisker plot; thus a zoomed plot to the social risk range of 0 and 10000 is also provided in Figure 4.15. As can be seen from Figure 4.15, although the mean value of social risk is 2406, social risks larger than 234 are classified as outliers. There are 11 EaR which resulted in social risks that are larger than 234. The maximum social risk is 199971 and calculated at Cairo Agricultural Area, which is followed by 9769 at Alexandria City Center. The third largest social risk is 2047 and occurred at Crete Summer Villages.

Table 4.4 Statistical summary of social risk for 91 EaR

	Economic Risk
Minimum	0
Mean	2406
Median	7
Maximum	199971

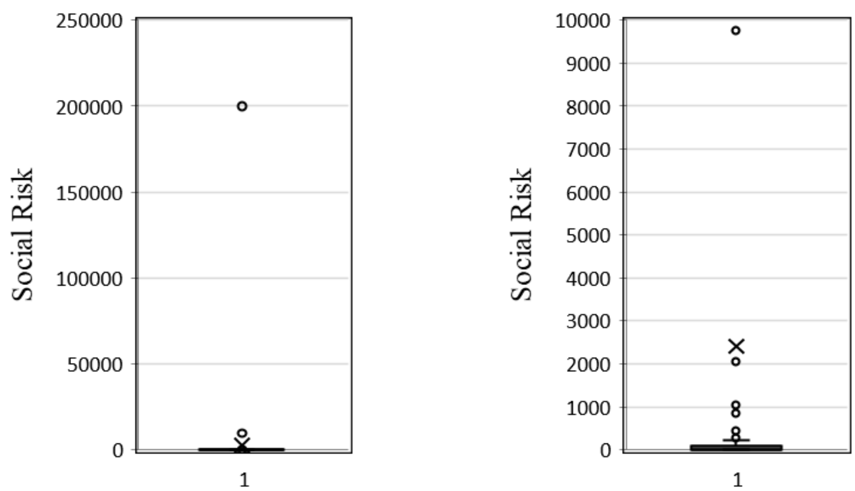


Figure 4.15 Box-whisker plot of social risk. Zoomed box-whisker plot of social risk is provided on the right.

In order to adjust social risk between zero and one, social risk values are also normalized with respect to the maximum risk (i.e. 199971). Normalized social risk map for the study area is given in Figure 4.16. Normalized risk value of each EaR is also given in Appendix-G. Social risk assessment is conducted for all 90 EaR except Palmachi Airbase in the study area. Because, Palmachi Airbase is a military base located in Israel coastline and there no information is available about the number of soldiers/people found in this EaR.

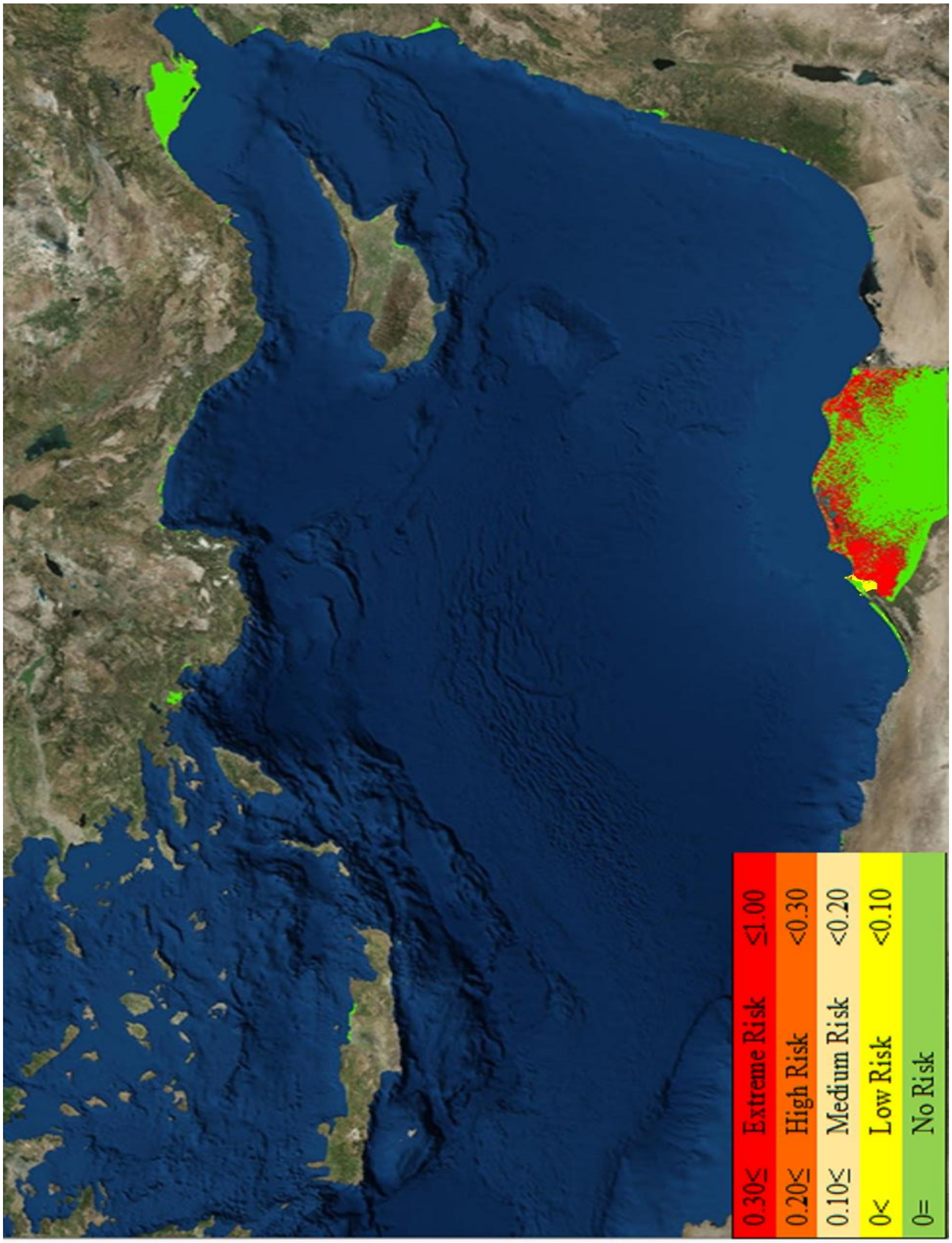


Figure 4.16 Normalized social risk map of the study area

Cairo Agricultural Area is densely populated and nearly 2.5 million people is estimated to be physically damaged based on MC simulation. Moreover, the vulnerability coefficient of Egypt (Table 3.6) is quite high and increases the social risk (Equation (3.10)). Consequently, Cairo Agricultural Area resulted in a much larger social risk compared to the other EaR. Thus, after normalization, only Cairo Agricultural Area is classified as EXTREME social risk. 86 out of 90 EaR resulted in NO normalized social risk. Alexandria City Center, Alanya Coastal District and Crete Summer Villages have LOW social risks. Normalized social risk maps for Alanya Coastal District, Crete Summer Villages and Alexandria City Center are shown in Figure 4.17.

It should be noted here that NO normalized social risk does not mean that nobody is physically damaged at these EaR; it rather means compared to that of physically damaged people at Cairo Agricultural Area, number of people physically damages at these EaR are negligible. To provide information on the total amount of affected people at each EaR, social damage with respect to inundation level at each EaR is given in Appendix-D.

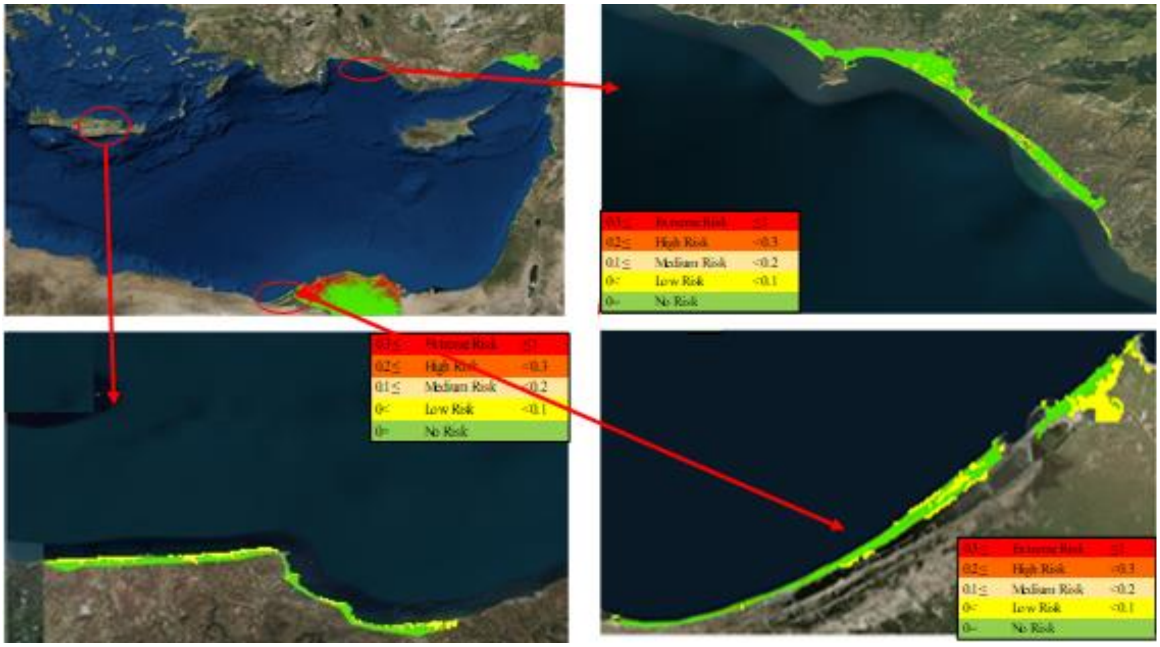


Figure 4.17 Normalized social risk maps for Alanya Coastal District (top right), Crete Summer Villages (bottom left) and Alexandria City Center (bottom right)

4.2.3 Environmental Risk Assessment

For EaR that are identified as environmental hazards environmental risks are calculated. Characteristics of the elements at environmental risk dimension is given in Table 4.5.

Table 4.5 EaR at economic risk dimension

Risk Dimension	Identification Criteria	Elements at Risk
Environmental Risk Dimension	Potential pollution	Chemical industry, Oil filling facilities, Oil refineries, Nuclear power plant, Waste water treatment plants

Binary approach is used to calculate environmental risk (i.e. each environmental EaR is estimated either to cause EXTREME or NO environmental risk). Areas of elements at environmental risk are too small to demonstrate in the whole study area. Therefore, environmental risk maps for Iskenderun Iron and Steel Factory, Atas Oil Refinery and Cimenterie Nationale Lebanon are given as sample maps in Figure 4.18.

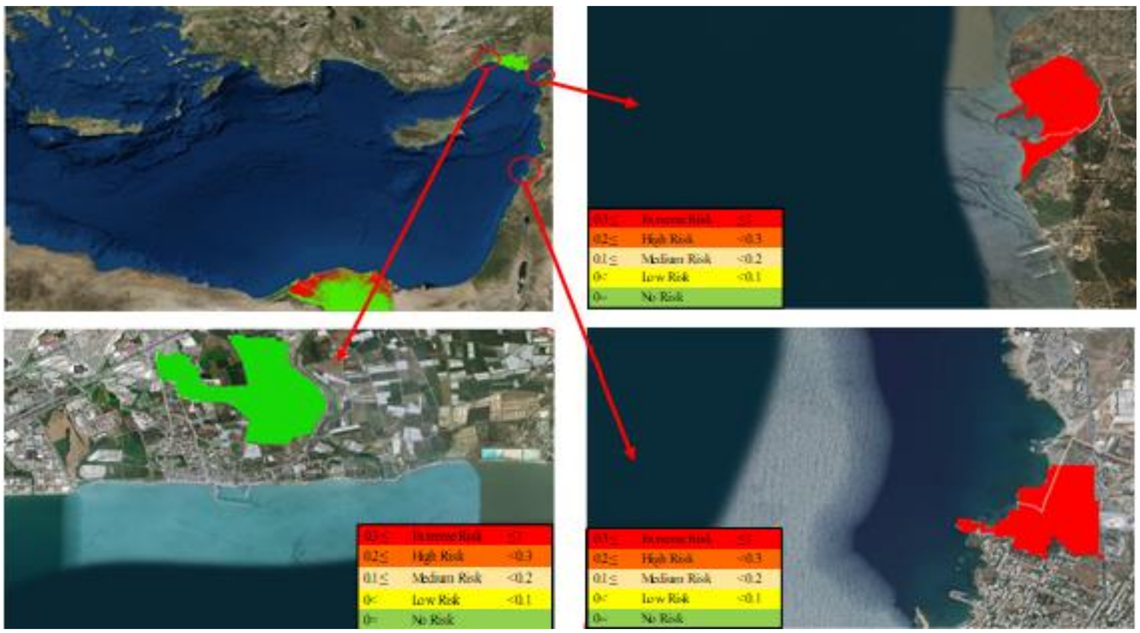


Figure 4.18 Environmental risk maps for Iskenderun Iron and Steel Factory (top right), Atas Oil Refinery (bottom left) and Cimenterie Nationale Lebanon (bottom right)

12 out of 16 environmental hazards are estimated to cause EXREME environmental risk based on MC simulations (see Figure 4.19). More specifically, IPT terminals, Antalya WWTP, Atas Oil Refinery and Kemer WWTP have NO environmental risk while the rest of the environmental hazards have EXTREME environmental risk.

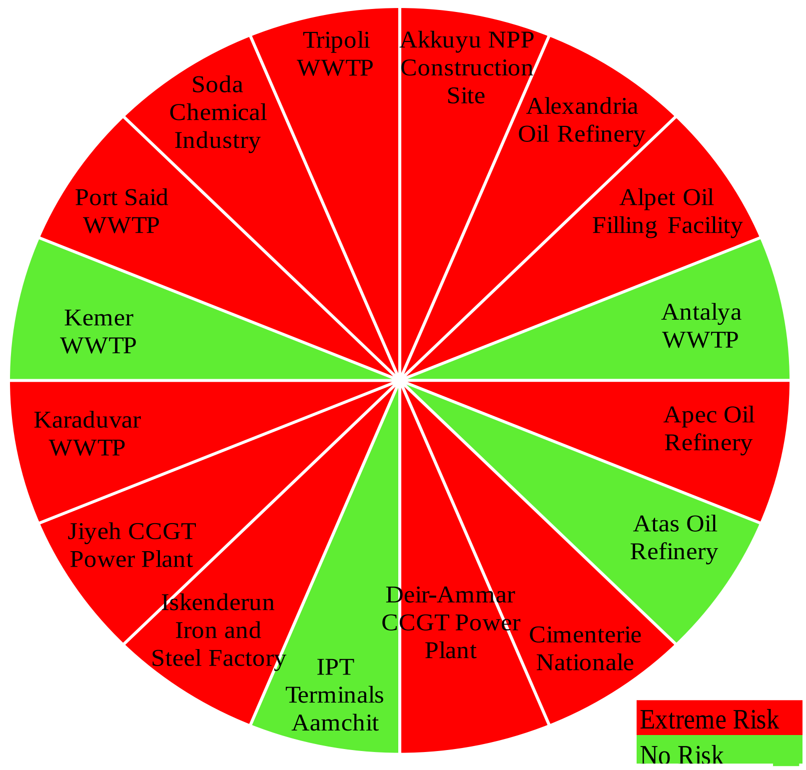


Figure 4.19 Elements at environmental risk in the study area

It can be resulted that EaR with NO environmental risk are all located at high altitudes from the sea level. Rest of the EaR are located adjacent to the sea.

4.2.4 Overall Risk Calculations

Overall risk maps are generated by aggregating economic, social and environmental risk dimensions to present a general perspective for all study area. Economic, social and environmental risk maps of the study area are given in Figure 4.5, Figure 4.16 and Figure 4.18, respectively. To obtain an overall risk value, first three dimensions of risk are aggregated using the "OR" operator which represents the worst-case scenario (i.e. the maximum of the three risk dimensions). Then the risk maps for the worst-case scenario are produced using ArcGIS tool (see Figure 4.20).

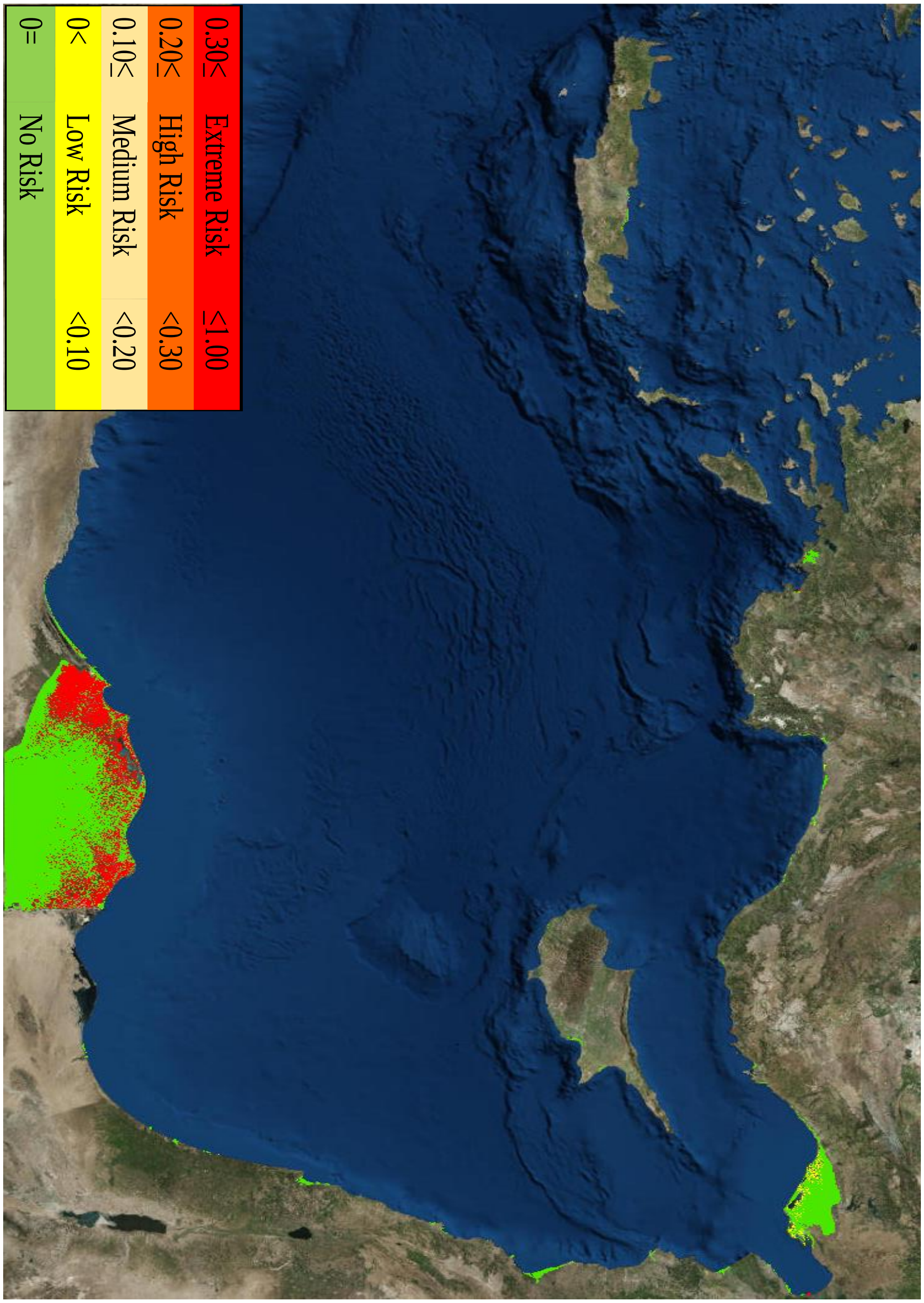


Figure 4.20 Overall risk map of the study area (Worst-case scenario)

It is cobncluded from the risk calculations that economic risk dimension commonly dominated the overall risk for residential and industrial damage classes since relative social risk is calculated as NO risk for 87 out of 91 EaR.

EaR identified as environmental hazards either have EXTREME risk or NO risk due to the binary approach. Therefore, environmental risk dimension is dominating in the overall risk calculations for EaR with environmental risk. Economic, social and environmental damage values with respect to inundation levels, tsunami wave height frequency plots and overall risk maps for the worst-case scenario are given for each EaR in Appendix-D. Additionally, overall risk estimates (worst-case scenario) of each EaR for two other scenarios, namely equal weight and economic risk weighted (Section 3.4.2.4) are given in Appendix-E. Overall risks for equal weight and economic risk weighted are given in Figure 4.21 and Figure 4.22 respectively. As can be seen from Figure 4.21 equal weight aggregation resulted in for instance MEDIUM risk for Alexandria City Center instead of EXTREME risk compared to the overall risk map generated for the worst-case scenario (see Figure 4.20). Additionally, NO risk obtained for Cukurova Agricultural Area for both equal weight and economic weighted overall risk calculations. This means that LOW economic risk is converted to NO risk when equal weight and economic weighted aggregations are used. Risks have been reduced by one or two levels in equal weight calculations for all EaR compared to the worst-case scenario except for Cairo Agricultural Area. However, increase in risks observed for economic weighted risk calculations due to domination of economic risk dimension on social risk dimension compared to that of equal weight risk maps. For example, EXTREME risk is calculated for Alexandria City Center both for worst-case and economic weighted risk calculations because of the domination of the economic risk dimension.

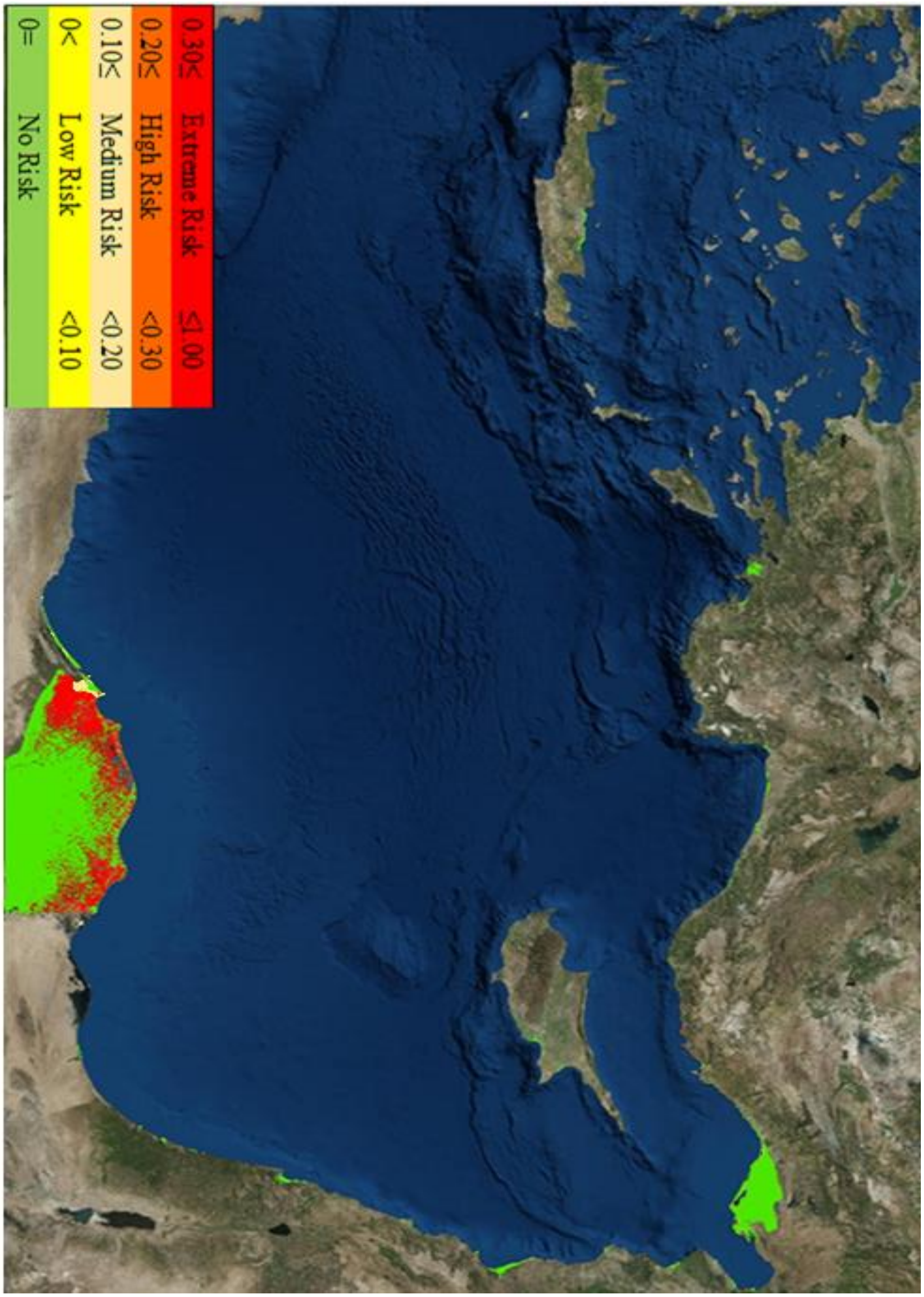


Figure 4.21 Equal weight risk map of the study area

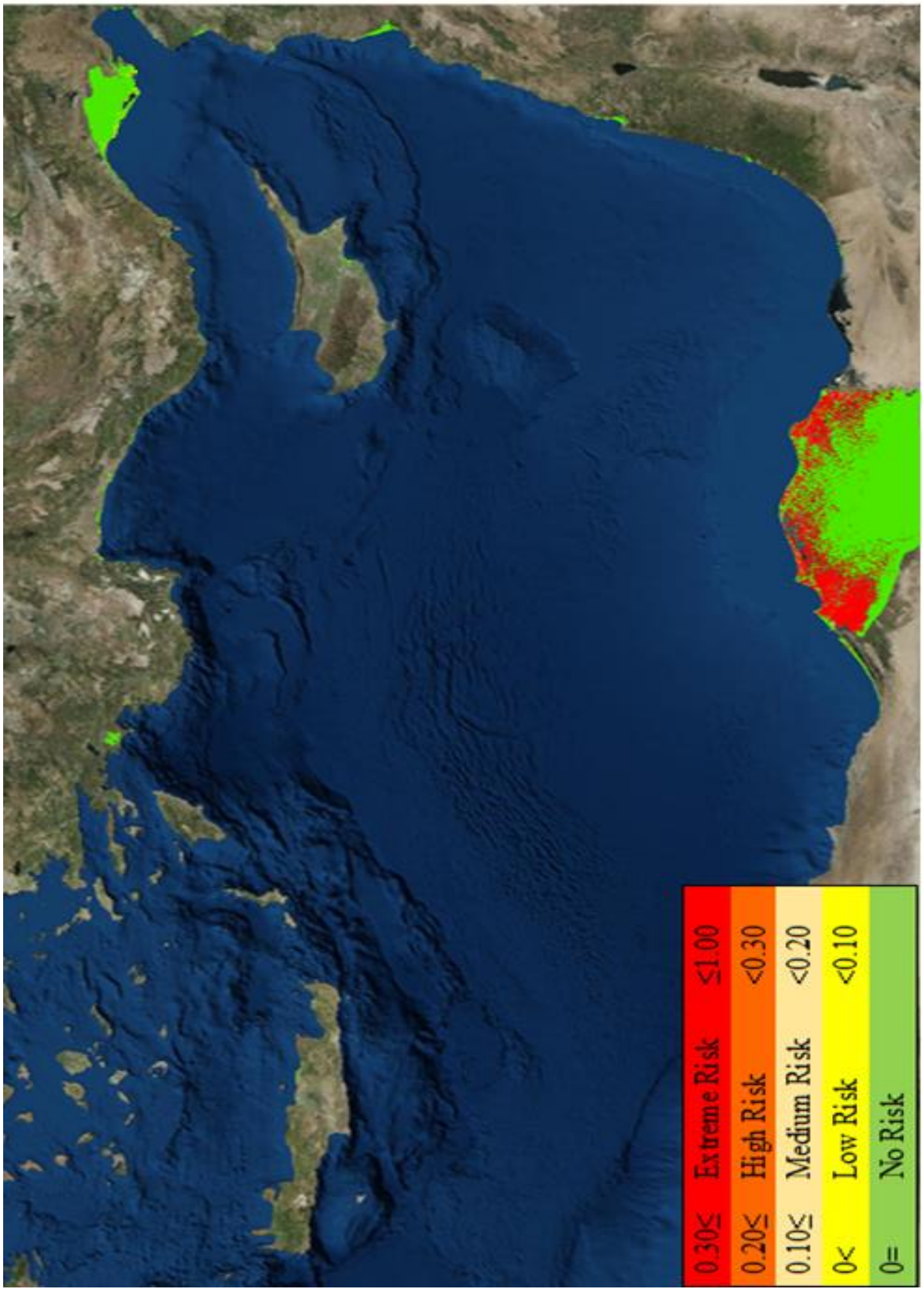


Figure 4.22 Economic weighted risk map of the study are

It can be concluded from these three different overall risk scenarios that the risks might change drastically for some of the EaR based on the aggregation method. Additionally, loss of information is also possible for some aggregations such as equal weight. Hence, the aggregation method has to be chosen according to the goal and case-specific conditions. The results should be evaluated and interpreted carefully and being aware of potential loss of information. If a proper aggregation method is used in accordance with the final goals of the study, generated overall risk maps should be beneficial for prioritizing the EaR that require attention. These overall maps might be useful especially for the authorities and private companies to plan their future investments for the selected region.

4.3 Positioning of Tsunami Early Warning System

The main goal of this part of the study is to reduce the overall social risk in the study area through positioning of a TEWS. To achieve this goal, the following heuristic is used: If the elements with considerably high social risk (EwHSR) are identified and a TEWS is places to reduce the social risk of these EwHSR, naturally high social risk reduction will be obtained for the whole study area as well.

In this study, the only way to reduce the social risk is assumed to inform people at EwHSR enough before the tsunami wave arrives so that they can walk to a safe altitude, as explained in Section 3.5. So, required time to reach the safe altitude (t_R) and remaining time to reach the safe altitude after tsunami warning (t_A) are calculated for all identified EaR in the study area. t_R for each EaR is calculated and given in Appendix-G. According to these calculations, people in most EaR can reach safe altitudes within less than 10 minutes on foot. The EaR that require greater than or equal to 10 minutes are considered as EwHSR in this study. These time calculations show that only five elements are under considerable social risk. EwHSR are listed in Table 4.6.

Table 4.6 Elements with considerably high social risk (EwHSR)

Risk Dimension	**Elements at Risk**	t_R **(minutes)**
Social Risk	Alexandria Airport	28
	Alexandria Oil Refinery	28
	Cairo Agricultural Area	174
	Cukurova Agricultural Area	18
	Dalaman Airport	10

Locations of TEWS are selected based on the relative social risk categories of the EwHSR. The heuristic behind the selection of TEWS locations is that the higher the distance between TEWS and EwHSR, the higher the social risk reduction for these elements and consequently for all the study area. The following steps are carried out to select the best location for the TEWS for the study area:

- TEWS positioning restrictions are given in Section 2.7. Additionally, Figure 3.19 shows these restrictions on the study area. These restrictions are used to reduce the potential TEWS positioning area. Potential locations within the reduced area are selected to place the TEWS based on the heuristic explained above to reduce the social risk as much as possible. Six potential locations identified to be evaluated for the TEWS are given in Figure 4.23.
- Eight critical tsunamigenic earthquakes that can cause significant damage are determined among 1000 randomly generated earthquakes and demonstrated in Figure 4.23.
- EwHSR are identified according to t_R and listed in Table 4.6.
- For each of the six TEWS positions, associated social risk reduction is calculated using the procedure explained in Section 3.5.2. The location resulting in the highest social risk reduction is identified as the best TEWS position.

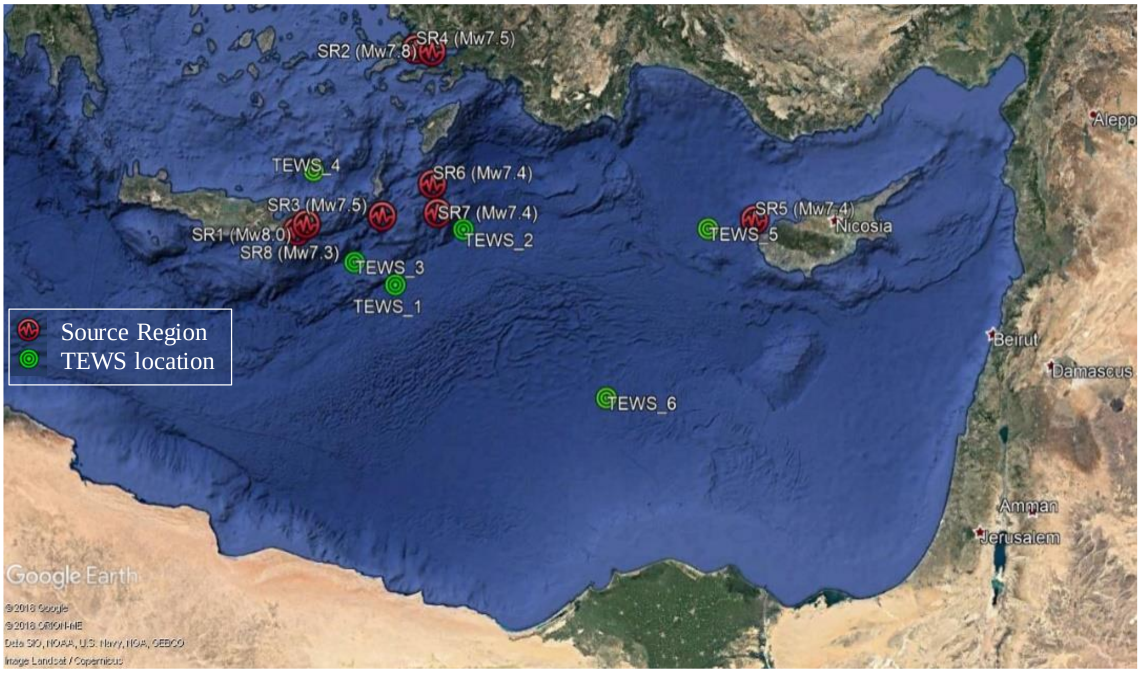


Figure 4.23 Earthquakes that could cause damage to EwHSR and selected TEWS locations

Longitude and latitude of the selected TEWS locations, coordinates of the earthquakes that could cause damage, ETAs from earthquake epicenter to buoy and to EaR, social risk coefficients according to t_R and t_A after TEWS deployment and social risk reduction percentages for each EwHSR are given in Appendix-G. Here, social risk reduction percentages for each EwHSR according to the tsunamigenic earthquakes (SR) and average socail risk reduction for all EwHSR are given in Table 4.7

Table 4.7 Social risk reduction percentages according to TEWS

TEWS Number	Source Region (SR)	Social Risk Reduction (%)				
		Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	All EwHSR
1	SR1	100	100	100	100	72
	SR2	0	34	100	50	
	SR3	100	37	100	100	
	SR4	43	25	100	0	
	SR5	64	5	100	10	
	SR6	100	57	100	60	
	SR7	100	34	100	100	
	SR8	100	36	100	100	
2	SR1	100	100	100	100	75
	SR2	100	100	100	100	
	SR3	100	26	100	70	
	SR4	100	35	100	80	
	SR5	0	0	100	0	
	SR6	100	64	100	100	
	SR7	0	0	100	100	
	SR8	100	27	100	100	
3	SR1	100	100	100	100	70
	SR2	0	38	100	100	
	SR3	100	38	100	100	
	SR4	39	25	100	0	
	SR5	39	1	100	0	
	SR6	100	54	100	10	
	SR7	100	36	100	100	
	SR8	100	40	100	100	
4	SR1	100	99	100	0	73
	SR2	100	90	100	100	
	SR3	100	27	100	80	
	SR4	100	34	100	70	
	SR5	0	0	0	0	
	SR6	100	49	100	0	
	SR7	100	40	100	100	
	SR8	100	42	100	100	
5	SR1	100	67	100	0	49
	SR2	100	70	100	100	
	SR3	57	0	100	0	
	SR4	0	6	100	0	
	SR5	100	25	100	100	
	SR6	0	0	100	0	
	SR7	0	0	0	100	
	SR8	29	11	100	0	
6	SR1	100	52	100	0	62
	SR2	29	52	100	100	
	SR3	100	0	100	0	
	SR4	0	3	100	0	
	SR5	100	13	100	100	
	SR6	100	11	100	0	
	SR7	100	11	100	100	
	SR8	71	18	100	20	

After all calculations, location of TEWS_2 was selected as the best location based on social risk reduction. The average social risk reduction percentage via positioning TEWS at location 2 is calculated as 75% for the whole study area (see Table 4.7). This result shows that significant amount of social risk reduction can be achieved by positioning a TEWS in the study area. Social risk calculations for each country are conducted as well to provide guidance for the country that wants to deploy a TEWS for its own sake and the numerical values are given in Appendix-F.

4.4 TEWS Positioning Based on Historical Earthquakes

In this section, three historical large earthquakes, namely 365AD Crete, 1222 Paphos and 1303 Crete (Figure 24) are used to identify the best TEWS location among the previously identified six locations. Same EwHSR listed in Table 4.6 are used in this analysis as well. TEWS positioning procedure is applied for each historical earthquake and the results are given in Table 4.8.

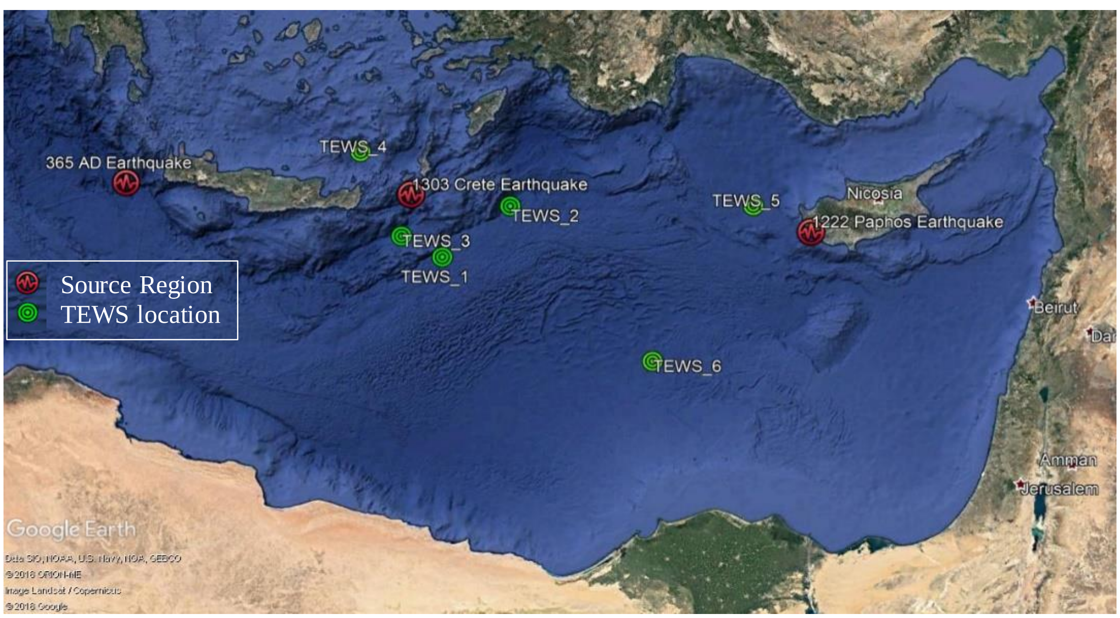


Figure 4.24 Locations of the historical earthquakes and TEWSs in the study area

Table 4.8 Social risk reduction percentages according to TEWS for historical earthquakes

Source Region (SR)	TEWS Number	Social Risk Reduction (%)					
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	All EwHSR
365	1	100	100	34	No Risk	100	67
	2	100	100	56	No Risk	100	71
	3	100	100	37	No Risk	100	67
	4	0	0	0	No Risk	0	0
	5	100	100	56	No Risk	100	71
	6	100	100	56	No Risk	100	71
1222	1	46	46	1	100	10	41
	2	71	71	5	100	80	65
	3	18	18	0	100	0	27
	4	0	0	0	22	0	4
	5	100	100	22	100	100	84
	6	100	100	13	100	100	83
1303	1	100	100	54	100	100	91
	2	0	0	0	100	0	20
	3	100	100	58	100	100	92
	4	0	0	13	100	0	23
	5	68	68	30	100	0	53
	6	0	0	19	100	0	24

As can be seen from Table 4.8, TEWS_2, TEWS_5 and TEWS 6 resulted in the maximum social risk reduction of 71% for 365AD Crete earthquake. On the other hand, TEWS_5 is identified as the best location for 1222 Paphos Earthquake. Whereas, TEWS_3 is selected as the best position for 1303 Crete earthquake. These results can shed light on future TEWS site selection studies in Eastern Mediterranean. Historical earthquakes, TEWSs and social risk reduction percentages according to the locations of the TEWSs and other supplemental information used in this analysis are given in Appendix-H.

5 CONCLUSION

In this thesis, a multi-dimensional risk assessment study is conducted. Social, economic, and environmental risks are calculated for 91 EaR located in 7 countries (i.e. Cyprus, Egypt, Greece, Israel, Lebanon, Turkey, and Syria). One thousand random earthquakes are generated, tsunamis due to these earthquakes are modeled using NAMI-DANCE software and MC simulations are conducted for risk assessment. Overall risks for each of the 91 EaR are calculated by aggregating economic, social and environmental risks. Overall risk maps of the study area are prepared. Moreover, a number of TEWS positions are evaluated in terms of social risk reduction in the study area.

Economic and social damage is directly related with the inundated areas. Thus, the topography of the coastlines and the EaR play a significant role in economic and social risk calculations. The results showed that although EaR in the European countries and Israel have high damage values, the inundated areas are too small compared to the EaR, especially in Egypt. Therefore, most of the EaR having EXTREME risks are observed in Egypt due to its large low-lying lands.

In terms of economic risk, a total number of 41 residential buildings (i.e. city centers and summer villages), 29 industrial facilities (i.e. industrial zones, ports-marinas and airports) and 5 agricultural regions are taken into consideration. According to the economic risk assessment results, 45 EaR have NO risk, 24 EaR have LOW risk, 1 EaR has HIGH risk, while 5 EaR have EXTREME risk values. Elements at EXTREME economic risk are Cairo Agricultural Area, Alexandria City Center, Fethiye City Center, Crete Summer Villages and Dalaman Airport.

Social risk assessment is conducted for 90 EaR. Palmachi Air Base did not have population information, thus excluded from the analysis. Since the number of physically damaged people is used as the consequence of social risk calculations, densely populated EaR such as Cairo Agricultural Area (approximately 2.5 million people) resulted in EXTREME social risk. Additionally, Alexandria City Center, Alanya Coastal District and Crete Summer Villages have LOW normalized social risk. It is concluded that normalized social risk in other EaR are negligible in comparison with that is observed in Cairo Agricultural Area.

Binary approach is used in this study for environmental risk calculations due to environmental pollution risk both for the soil and the sea. 16 EaR (i.e. oil filling facilities, oil refineries, nuclear power plant construction site, chemical industry, wastewater treatment plants and factories) are considered as environmental hazards and 12 of them resulted in EXTREME risk while the remaining four do not have any environmental risk.

Overall risk maps and numerical results are also presented in this study. By aggregating economic, social and environmental risk dimensions using different aggregation methods (i.e. worst-case/the “OR operator, equal weight and economic weighted) overall risk maps are generated. It is believed that the overall maps will be useful for the authorities in developing disaster management strategies and for the private companies for their future investments.

One potential use of the results of risk assessment calculations is TEWS positioning. Reduction in social risk is used to evaluate potential TEWS locations to provide reliable tsunami early warning for the area. In this study, a number of potential TEWS locations are evaluated for six critical earthquakes selected from 1000 MC simulations and TEWS_2 (35.45°N/28.21°E) is identified as the best-location among the selected set. A similar analysis is conducted for three historical earthquakes (i.e. 365 AD Crete, 1222

Paphos and 1303 Crete) as well. The best TEWS locations are identified based on social risk reductions of these three earthquakes. It is concluded from the social risk reduction percentages that TEWS_5 (35.06°N/31.38°E) is the best TEWS location for 365AD Crete and 1222 Paphos earthquakes. TEWS_2 (35.45°N/28.21°E) and TEWS_6 (33.19°N/30.16°E) locations result in the same social risk reduction percentage for 365AD Crete earthquake as well. Whereas the location of TEWS_3 is identified as the best location for 1303 Crete earthquake.

A scientific research was initiated by North-Eastern Atlantic, Mediterranean and connected seas Tsunami Information Centre (NEAMTIC) in 2011 at North-Eastern Atlantic, Mediterranean and connected seas on the deployment of a tsunami early warning system in the Mediterranean Sea (Web 5.1). NEAMTIC's project is still in progress. It is believed that the results of the current study may provide valuable input for NEAMTIC.

It can be concluded from the results of this study that, Eastern Mediterranean Sea and the countries having coastline along this region are under economic, social and environmental risk due to probable tsunami hazard. Results of this study will provide critical information in developing disaster management and risk minimization strategies especially for the authorities in Cyprus, Egypt, Greece, Israel, Lebanon, Syria and Turkey.

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APPENDIX A - HISTORICAL EARTHQUAKE DATA OBTAINED FROM TRANSFER PROJECT

This appendix includes 523 historical earthquake source parameters that are used in this study to conduct tsunami simulations in the study area. The data is compiled from EU funded TRANSFER (Tsunami Risk ANd Strategies For the European Region) Project (Web 2.4).

Table A.1 523 historical earthquake data obtained from TRANSFER project

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
450	36.50	28.60	58	85	19	7.2	1
451	36.50	28.60	304	58	-175	7.2	-
4103	36.70	25.80	65	45	-90	7.2	-
98	35.50	27.00	190	62	-90	7.1	40
1714	37.90	30.40	222	42	-107	7.0	-
1242	36.40	28.60	233	14	126	6.9	-
1243	36.40	28.60	114	29	28	6.9	-
5522	34.49	32.12	40	64	162	6.8	85
5524	34.49	32.12	40	64	162	6.8	85
4953	32.90	29.80	215	72	22	6.7	-
60	35.75	25.00	270	69	112	6.7	80
2265	37.60	27.25	55	51	-137	6.7	-
6846	34.56	32.13	48	77	170	6.6	33
6795	32.20	29.60	315	59	36	6.6	-
6864	34.70	24.70	320	80	-164	6.5	-
2612	36.70	27.40	60	45	-90	6.5	-
6168	33.75	28.50	220	45	90	6.5	80
5766	34.40	24.50	268	75	-163	6.5	-
65	35.79	26.62	18	35	-163	6.4	88
5764	34.40	24.50	127	25	51	6.4	-
5765	34.40	24.50	162	19	82	6.4	-
6688	34.90	27.40	294	31	26	6.4	-
6920	34.90	27.40	56	67	-168	6.4	-
6921	34.90	27.40	54	70	176	6.4	-
1239	36.40	27.30	13	77	172	6.4	-
1240	36.40	27.30	8	22	-154	6.4	-
3965	36.60	28.30	89	62	90	6.3	72
1747	37.00	28.50	8	40	-3	6.3	-
97	35.50	27.00	325	70	90	6.2	130
454	36.53	35.33	50	85	10	6.2	32
43	36.10	29.20	100	74	82	6.2	7
1638	37.65	29.72	64	50	-75	6.2	-
6689	34.90	32.20	150	23	-34	6.2	-
6690	34.90	32.20	26	64	171	6.2	-
6691	34.90	32.20	145	67	13	6.2	-
6977	35.30	24.50	239	42	-20	6.2	-
1166	36.20	28.90	193	24	3	6.2	-
72	35.80	29.70	216	40	-13	6.2	30

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
5523	34.49	32.12	48	77	170	6.1	23
2340	37.70	28.89	276	69	-131	6.1	4
5916	35.10	26.60	172	38	-106	6.1	20
6545	35.10	26.60	172	38	-106	6.1	20
6546	35.10	26.60	172	38	-106	6.1	20
1076	36.07	27.46	9	53	-114	6.1	12
5521	34.49	32.12	125	12	-73	6.1	25
6926	34.92	24.27	63	76	157	6.1	24
896	35.58	24.72	177	63	22	6.1	77
3186	37.20	28.20	65	45	-90	6.0	-
1713	37.90	29.60	64	50	-75	6.0	-
1605	36.88	35.31	321	75	171	6.0	33
6712	35.40	27.90	314	25	119	6.0	27
1253	36.60	26.90	57	46	-72	6.0	7
653	36.15	27.10	196	38	-102	6.0	33
436	36.41	31.75	48	27	-133	5.9	98
6711	35.40	27.90	314	25	119	5.9	7
5770	34.40	28.90	60	35	80	5.9	-
5767	34.40	24.95	163	50	44	5.8	31
1215	36.36	26.95	339	32	-177	5.8	132
5359	35.04	32.27	239	21	140	5.8	15
6852	34.59	32.21	56	68	175	5.8	76
5915	35.10	26.60	214	52	-47	5.8	7
3964	36.60	27.00	140	82	30	5.8	-
5776	35.07	26.71	172	38	-106	5.8	17
108	35.55	28.16	348	67	-179	5.7	50
825	36.24	31.34	132	64	155	5.7	67
2266	37.60	29.70	73	14	-90	5.7	-
5162	34.31	32.33	118	87	-12	5.7	41
1152	36.18	31.51	150	75	90	5.7	79
2297	37.91	28.53	325	42	-36	5.7	9
4660	34.53	24.44	172	4	-20	5.7	33
6805	33.39	35.45	104	35	-167	5.7	10
6794	32.20	29.50	35	25	90	5.6	-
6826	35.18	25.36	358	39	131	5.6	75
218	36.05	27.76	103	46	24	5.6	85
3973	36.63	24.27	258	80	177	5.6	97
3993	36.35	29.39	94	75	104	5.6	22
4981	34.75	33.04	92	64	67	5.6	11
6847	34.56	32.21	139	53	12	5.6	33

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6881	35.00	33.90	95	45	110	5.6	-
6090	35.20	33.60	248	46	144	5.6	-
81	35.86	25.96	225	73	-160	5.6	-
91	35.50	25.50	130	75	90	5.6	25
6863	34.70	24.10	55	58	117	5.6	-
5913	35.10	24.60	240	65	34	5.6	-
42	36.10	27.40	350	30	142	5.6	73
1173	36.10	27.40	350	30	142	5.6	73
6775	30.50	35.50	176	36	19	5.6	-
6420	34.96	24.24	216	11	10	5.5	33
6995	35.40	25.90	7	16	114	5.5	10
6837	34.42	26.38	132	46	110	5.5	30
4656	34.51	26.59	135	76	13	5.5	59
2366	36.69	26.96	312	46	162	5.5	159
2615	37.20	36.17	22	39	-61	5.5	5
2236	37.96	28.59	320	57	-39	5.5	24
2744	37.84	29.33	87	48	-125	5.5	33
1065	37.80	29.40	189	2	146	5.5	-
1066	37.80	29.40	81	10	44	5.5	-
6892	34.82	26.28	245	36	-33	5.5	18
6680	34.06	24.68	67	53	29	5.5	33
710	36.25	35.95	243	39	-15	5.5	10
4844	34.22	25.69	276	43	80	5.5	38
5163	34.31	32.33	97	76	-11	5.5	33
4000	36.30	27.50	118	84	38	5.4	89
6547	35.10	26.60	214	52	-47	5.4	7
280	36.10	26.80	275	85	-174	5.4	33
3998	36.30	27.50	246	21	-11	5.4	89
3999	36.30	27.50	246	21	-11	5.4	89
5596	31.40	27.67	154	44	89	5.4	10
6830	35.19	26.25	209	75	131	5.4	72
4659	34.53	24.38	30	37	71	5.4	74
3970	36.62	27.09	315	44	173	5.4	159
6091	35.20	35.60	259	69	0	5.4	10
2691	36.56	30.71	178	30	4	5.4	70
1151	36.17	31.81	65	20	-90	5.4	106
5167	34.37	26.35	284	53	38	5.4	10
6839	34.43	26.24	234	4	58	5.4	10
5360	35.04	32.31	71	34	-9	5.4	10
6445	35.27	27.12	234	41	-23	5.4	24

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
5528	34.50	25.26	225	14	40	5.4	42
6853	34.60	25.50	230	68	-148	5.4	-
6088	35.20	27.70	200	69	4	5.4	-
1241	36.40	27.70	194	67	167	5.4	-
452	36.50	35.70	15	30	-60	5.4	-
6548	35.10	27.20	149	81	8	5.4	-
2611	36.70	26.30	74	54	46	5.4	-
5679	34.79	32.94	302	42	124	5.4	33
5166	34.36	26.03	289	38	110	5.3	10
5961	34.74	34.41	343	27	133	5.3	10
6968	35.06	32.26	224	20	133	5.3	10
899	35.95	27.42	53	19	-129	5.3	93
62	35.76	28.64	342	73	177	5.3	33
1652	37.04	28.21	103	27	-74	5.3	5
619	37.06	28.29	92	36	-94	5.3	10
1565	37.30	36.30	181	34	-122	5.3	10
1153	36.18	31.51	67	23	-149	5.3	79
1277	36.80	29.40	336	49	48	5.3	31
6778	30.75	30.50	245	71	-145	5.3	-
6879	35.00	27.10	188	31	-21	5.3	-
692	36.90	28.50	175	27	-130	5.3	-
4657	34.51	26.59	227	37	23	5.3	30
18	35.65	29.80	104	8	-72	5.3	32
34	35.70	25.00	238	29	33	5.3	100
6838	34.42	26.57	107	76	169	5.3	32
4847	34.30	26.10	103	8	-68	5.3	10
1259	36.65	26.27	71	25	-83	5.3	25
3969	36.62	24.55	105	36	-81	5.3	13
5520	34.48	32.13	14	53	165	5.3	10
5325	35.29	28.67	25	32	-152	5.3	10
6808	33.60	27.50	42	59	-169	5.2	33
6865	34.80	32.90	100	40	100	5.2	-
94	35.50	26.40	61	35	-40	5.2	11
95	35.50	26.40	61	35	-40	5.2	11
96	35.50	26.40	61	35	-40	5.2	11
5683	34.80	24.10	289	22	75	5.2	25
5684	34.80	24.10	289	22	75	5.2	25
5685	34.80	24.10	289	22	75	5.2	25
4292	37.30	29.90	206	64	-179	5.2	-
4293	37.30	29.90	263	12	-155	5.2	-

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6378	34.79	24.15	319	6	123	5.2	15
6891	34.82	24.28	235	39	-8	5.2	33
6929	34.92	26.75	129	27	-106	5.2	33
652	36.83	27.82	63	27	-115	5.2	10
13	35.63	27.49	353	38	-80	5.2	17
215	36.04	26.91	213	38	-67	5.2	25
6127	35.16	27.15	234	77	4	5.2	33
1223	36.37	28.04	12	30	176	5.2	75
1255	36.63	26.92	92	71	8	5.2	155
3212	37.02	27.72	60	43	-108	5.2	2
826	36.24	35.92	224	52	-35	5.2	10
6857	34.63	28.36	99	37	-53	5.2	10
1911	37.02	27.92	271	37	-92	5.2	9
6998	35.48	26.32	61	35	-40	5.2	33
775	37.00	29.64	65	47	-114	5.2	10
784	37.01	28.25	90	41	-101	5.2	11
5165	34.35	26.16	119	45	114	5.2	-
1165	36.20	27.10	104	72	-167	5.2	7
4843	34.21	26.16	83	10	37	5.2	10
4794	34.39	28.30	67	48	-34	5.2	15
6813	33.74	35.46	87	43	-178	5.2	10
1276	36.80	29.30	160	65	180	5.2	-
6917	34.90	26.30	144	70	86	5.2	2
6918	34.90	26.30	144	70	86	5.2	2
5	35.60	24.50	191	65	-79	5.2	13
5768	34.40	25.20	120	63	90	5.2	33
5527	34.50	25.10	286	75	-107	5.2	33
6854	34.60	26.30	143	69	85	5.2	33
2739	37.83	27.00	262	41	-127	5.2	33
6860	34.64	25.59	77	10	-118	5.1	17
6	35.60	27.00	146	46	110	5.1	75
35	35.70	30.60	302	69	165	5.1	75
6374	34.77	26.37	252	22	1	5.1	10
4658	34.51	26.65	15	55	-11	5.1	12
5161	34.19	26.15	292	40	96	5.1	20
6174	34.00	25.50	296	37	111	5.1	33
4704	34.50	32.06	62	48	-168	5.1	33
6890	34.81	32.86	307	26	116	5.1	33
4795	34.85	32.29	147	62	4	5.1	33
6129	35.16	27.26	147	44	-117	5.1	10

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
691	36.90	27.90	83	36	-103	5.1	33
202	36.02	28.39	10	34	-116	5.1	72
76	35.81	29.75	207	39	-34	5.1	20
4703	34.50	25.60	133	21	115	5.1	14
4950	32.75	24.37	326	40	-7	5.1	10
6859	34.64	25.50	3	38	150	5.1	33
1112	37.40	36.20	156	30	-159	5.1	39
1258	36.65	24.53	113	45	-90	5.1	11
509	36.95	30.92	130	41	125	5.1	112
2306	37.92	29.05	135	28	-93	5.1	8
2212	37.47	35.85	141	90	180	5.1	41
2339	37.70	27.80	83	27	-90	5.1	-
709	36.25	28.28	38	55	170	5.1	29
6880	35.00	27.48	214	60	-34	5.1	33
5686	34.80	24.70	264	61	44	5.1	33
1187	36.87	35.32	72	55	8	5.1	33
4475	37.95	26.74	42	75	172	5.1	-
693	36.90	29.09	139	36	-83	5.1	33
5771	34.40	32.11	324	73	-17	5.1	16
1671	37.76	29.44	113	39	-77	5.1	17
2619	37.21	36.01	160	27	-136	5.1	33
6900	34.85	25.06	256	65	-11	5.1	44
5599	31.60	30.20	307	7	-110	5.1	10
6893	34.83	24.25	289	22	76	5.0	19
6928	34.92	26.26	223	19	33	5.0	60
17	35.65	26.18	93	20	-94	5.0	87
1284	36.83	27.83	68	36	-100	5.0	10
687	36.89	27.85	71	31	-99	5.0	20
6710	35.40	27.62	212	45	-29	5.0	30
9	35.62	27.68	43	59	-21	5.0	33
4258	36.73	28.24	275	52	-34	5.0	33
2827	36.77	28.13	316	54	137	5.0	88
6437	35.24	27.12	5	10	8	5.0	31
5598	31.50	35.50	161	71	-113	5.0	-
5687	34.80	27.40	34	67	157	5.0	10
64	35.78	29.70	207	75	8	5.0	51
6086	35.20	26.70	306	78	-90	5.0	33
6702	35.34	27.47	309	32	98	5.0	45
6841	34.44	26.50	184	46	-40	5.0	21
6910	35.12	27.81	1	39	-146	5.0	10

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6175	34.01	25.88	138	80	178	5.0	15
5580	34.20	25.80	122	15	119	5.0	10
2613	37.20	29.00	275	41	-139	5.0	-
688	36.90	35.44	60	90	20	5.0	37
655	36.15	27.22	222	36	-78	5.0	33
6858	34.63	33.86	70	35	50	5.0	-
36	35.70	30.80	30	70	170	5.0	-
5763	34.40	24.20	296	59	47	5.0	33
4966	35.08	26.52	105	72	-177	4.9	54
4979	34.71	32.89	285	16	71	4.9	33
2743	37.84	26.81	271	49	-132	4.9	10
1254	36.60	26.90	315	50	164	4.9	142
6169	33.80	25.62	242	78	9	4.9	10
678	36.97	35.46	224	71	-12	4.9	10
620	37.06	36.13	207	42	-80	4.9	10
2220	37.52	36.20	30	41	-79	4.9	10
134	36.88	31.54	350	47	134	4.9	135
2316	37.99	30.92	158	45	-129	4.9	5
1274	36.80	26.40	231	84	-180	4.9	-
5688	34.80	32.10	190	52	63	4.9	-
4849	34.30	32.50	270	70	-160	4.9	-
6379	34.80	32.10	190	52	63	4.9	-
37	35.70	30.80	5	65	130	4.9	-
3595	35.91	30.61	185	60	10	4.9	-
1799	37.80	27.60	47	71	147	4.9	-
4975	34.70	25.25	127	86	-11	4.9	33
5769	34.40	26.10	151	70	144	4.9	33
3997	36.30	26.70	279	89	179	4.9	-
4254	36.30	26.70	278	86	-176	4.9	-
93	35.50	26.00	272	12	132	4.9	175
6784	31.80	33.50	44	42	114	4.9	100
5160	34.19	25.80	262	40	102	4.8	10
6878	35.00	26.50	264	41	16	4.8	10
4792	34.98	26.25	268	78	-1	4.8	33
6966	35.06	25.96	209	41	-78	4.8	33
5960	34.74	24.85	125	3	-64	4.8	41
5164	34.33	33.25	335	27	133	4.8	50
39	35.72	31.57	43	10	172	4.8	52
6128	35.16	27.17	333	56	-157	4.8	10
57	35.74	27.83	349	45	-76	4.8	10

Object ID	Latitude	Longitude	Strike (0)	Dip (0)	Rake (0)	M_w	Focal Depth (km)
1288	36.84	27.85	83	23	-83	4.8	10
5321	35.28	27.79	325	42	-140	4.8	29
6439	35.24	27.36	294	49	134	4.8	58
5357	35.04	27.43	323	73	162	4.8	68
6888	34.81	27.20	40	70	2	4.8	33
6776	30.59	31.64	54	52	-151	4.8	-
6684	34.12	25.75	305	44	124	4.8	33
6685	34.14	25.72	58	51	42	4.8	10
2208	37.39	36.34	231	58	-37	4.8	8
1663	37.05	36.08	10	45	-106	4.8	10
4255	36.70	35.88	204	28	-93	4.8	41
4297	37.42	36.20	170	40	-90	4.8	14
411	36.93	35.89	285	85	-140	4.8	32
4976	34.70	26.30	200	58	88	4.8	33
6443	35.25	35.43	219	43	-10	4.8	27
6844	34.46	26.09	306	33	116	4.8	34
6997	35.40	26.42	31	70	101	4.8	33
4978	34.71	24.28	357	48	-128	4.8	15
965	37.93	28.67	295	34	-88	4.8	5
5821	34.47	26.58	185	40	-27	4.8	33
4661	34.53	24.94	176	78	-171	4.8	33
6894	34.83	24.59	360	49	155	4.8	56
5694	35.14	27.71	315	82	174	4.8	33
823	36.23	28.45	11	26	-57	4.8	67
449	36.50	27.07	334	54	-160	4.8	166
6438	35.24	27.18	216	39	-27	4.8	24
5525	34.49	32.72	125	50	131	4.8	33
6549	35.10	30.54	265	68	-171	4.8	33
4288	37.28	35.88	89	62	26	4.8	12
1798	37.80	24.20	224	41	168	4.8	18
6171	33.88	24.16	179	72	-14	4.8	10
1569	37.31	24.67	256	50	16	4.8	174
1903	37.01	28.32	93	32	-85	4.8	10
194	36.00	27.45	199	50	-52	4.7	9
6919	34.90	26.90	227	44	7	4.7	42
1275	36.80	26.70	124	26	72	4.7	-
1086	36.14	31.16	70	79	-4	4.7	66
6840	34.44	26.51	309	74	-177	4.7	20
6896	34.84	25.80	180	41	-96	4.7	33
6851	34.59	26.19	23	50	-151	4.7	66

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6991	35.38	27.28	133	52	-168	4.7	20
3205	36.32	28.27	315	41	-93	4.7	33
5358	35.04	27.46	51	48	-29	4.7	70
2686	36.54	27.88	345	62	172	4.7	77
1265	36.79	34.35	26	15	-95	4.7	9
6883	35.01	24.68	279	55	-35	4.7	27
405	36.79	27.83	73	34	-99	4.7	9
6930	34.92	25.18	173	47	-144	4.6	12
1788	37.76	26.70	231	75	-172	4.6	15
6969	35.07	24.32	311	66	47	4.6	20
3861	36.48	28.11	117	40	85	4.6	63
2203	37.37	36.25	350	40	-100	4.6	15
6901	34.85	25.36	248	61	1	4.6	11
6687	34.16	26.16	104	77	173	4.6	18
4848	34.30	26.17	8	40	-159	4.6	33
4793	34.38	26.23	219	38	30	4.6	33
6962	35.06	25.39	281	65	16	4.6	33
6873	35.00	24.22	314	73	-174	4.6	62
1260	36.67	28.03	239	29	-105	4.6	5
1175	36.13	27.52	170	32	-62	4.6	19
699	36.27	27.17	211	40	-31	4.6	28
5695	35.14	27.82	248	65	-1	4.6	33
6831	35.19	27.54	62	75	12	4.6	33
222	36.07	27.34	235	67	24	4.6	56
700	36.27	27.78	342	70	161	4.6	67
6807	33.55	33.13	93	73	-6	4.6	33
40	35.97	30.58	21	45	-147	4.6	61
6889	34.81	27.28	255	74	-17	4.6	68
4797	34.86	26.07	5	35	120	4.6	39
66	35.79	28.49	78	61	-24	4.6	68
5772	34.40	32.29	55	35	177	4.6	34
869	37.13	28.80	96	47	-110	4.6	33
1646	37.70	29.18	153	41	-41	4.6	8
1904	37.01	28.34	276	41	-56	4.6	10
2614	37.20	35.10	161	34	-175	4.6	100
1256	36.63	31.41	188	37	6	4.6	124
1635	37.10	30.85	117	38	94	4.6	124
133	36.88	27.70	60	37	-112	4.5	10
82	35.87	36.28	295	85	-2	4.5	33
207	36.03	32.32	326	75	-173	4.5	33

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
1564	37.26	26.89	70	40	-90	4.4	20
6843	34.45	25.64	78	77	6	4.4	27
6967	35.06	26.41	78	64	-21	4.4	12
6849	34.58	24.77	47	34	-115	4.4	33
4232	35.92	27.18	347	35	-111	4.4	5
1079	36.08	26.48	328	64	-169	4.4	90
6087	35.20	27.12	244	57	-5	4.4	18
99	35.51	25.86	246	56	-11	4.4	6
820	36.23	35.28	65	45	-10	4.4	6
1653	37.04	35.85	35	75	-10	4.4	23
6809	33.65	25.50	345	85	-179	4.3	30
4257	36.72	27.51	193	65	162	4.3	57
4845	34.23	25.25	110	33	-83	4.3	21
6717	35.44	24.81	155	68	-21	4.3	28
2617	37.20	35.77	125	85	150	4.3	15
5526	34.49	32.07	44	86	-173	4.3	21
6789	32.05	35.05	13	72	3	4.3	19
6925	34.91	24.72	321	89	-3	4.3	18
6862	34.69	32.96	240	31	47	4.3	12
2365	36.69	26.21	157	49	-31	4.2	18
16	35.65	25.99	179	57	-68	4.2	25
1906	37.01	35.58	65	80	20	4.2	22
206	36.03	27.02	189	42	-72	4.2	9
38	35.71	29.30	192	25	-43	4.2	31
6777	30.69	31.69	295	14	-178	4.2	-
618	37.06	28.21	92	38	-85	4.2	9
4947	32.48	35.46	255	41	-130	4.2	12
6683	35.05	26.11	40	90	175	4.2	19
1208	37.00	26.79	20	49	-41	4.1	16
5908	35.09	26.12	254	71	-66	4.1	24
1559	37.25	26.91	109	49	-90	4.0	16
1550	36.99	26.81	88	51	-69	4.0	13
6791	32.12	35.39	100	60	-80	4.0	2
5820	35.05	26.11	70	71	16	4.0	22
5356	35.04	27.23	56	67	10	3.9	24
6799	33.05	34.58	311	82	40	3.9	25
6696	34.91	24.80	142	22	-35	3.9	20
5355	35.04	26.12	240	85	-60	3.9	22
6371	34.76	25.81	35	50	150	3.9	44
6373	34.77	25.82	54	58	-42	3.9	45

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6814	34.88	25.75	40	49	-90	3.8	7
4945	32.35	35.47	349	81	-5	3.8	11
4971	35.09	26.07	267	81	-20	3.8	22
4980	34.75	25.74	18	76	117	3.8	42
2	35.59	26.99	310	44	98	3.7	13
1549	36.99	26.80	109	41	-70	3.7	15
6812	33.74	35.19	130	85	10	3.7	12
6370	34.73	25.82	24	58	-42	3.7	41
6868	34.81	25.81	40	50	140	3.7	50
1558	37.25	26.87	260	49	-98	3.7	10
680	36.98	26.81	10	44	-82	3.7	15
3976	37.77	26.89	344	54	93	3.7	32
6790	32.09	35.49	120	70	-40	3.7	12
6797	32.29	35.41	1	71	-26	3.7	12
6823	35.17	25.77	12	48	-59	3.7	13
6939	34.94	26.10	90	65	-170	3.7	35
908	36.82	27.25	329	75	90	3.6	18
660	36.16	28.14	130	49	97	3.6	19
391	37.63	26.72	10	49	108	3.6	21
6793	32.16	35.27	330	85	20	3.6	12
4946	32.46	35.28	301	35	-59	3.6	12
6800	33.11	34.74	141	85	-60	3.6	24
6950	34.98	25.69	75	70	-30	3.6	17
4972	35.09	26.11	238	74	-70	3.6	22
4285	37.27	26.88	99	49	-77	3.5	19
6875	35.00	25.09	85	55	-100	3.5	9
5637	35.03	24.93	150	35	11	3.5	11
654	36.15	27.20	130	40	-148	3.4	14
2364	36.69	25.74	280	70	-47	3.4	15
63	35.77	25.39	160	60	-138	3.4	16
6909	35.12	25.05	140	49	119	3.4	20
77	35.82	24.97	140	49	-90	3.4	24
6982	35.31	27.38	150	80	0	3.4	25
6092	35.21	26.01	75	70	150	3.4	16
6885	35.03	25.82	186	58	42	3.4	17
4970	35.09	26.04	58	80	15	3.4	20
456	36.59	25.56	99	49	-128	3.3	-
6958	35.06	24.92	335	30	-90	3.3	8
4965	35.08	26.20	292	75	-42	3.3	29
47	36.11	27.21	0	40	-114	3.3	13

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6996	35.40	26.18	0	20	40	3.3	17
92	35.50	25.76	192	41	-73	3.3	24
656	36.15	27.51	184	70	-90	3.3	33
4094	35.24	26.01	15	55	80	3.3	18
56	35.73	24.68	240	80	25	3.2	18
659	36.16	27.26	140	30	90	3.2	18
48	36.11	27.38	94	54	86	3.2	22
5638	35.03	25.08	20	85	-150	3.2	9
6861	34.67	24.88	180	40	60	3.2	24
30	35.69	25.71	157	49	-108	3.1	8
281	36.10	27.23	295	10	93	3.1	12
6961	35.06	25.07	320	50	41	3.1	9
6867	34.81	25.39	140	50	-119	3.1	23
5773	35.07	25.89	242	74	70	3.1	14
6934	34.93	25.04	359	26	76	3.1	15
5353	35.04	26.10	50	45	30	3.1	18
6946	34.95	26.10	340	55	-30	3.1	39
1209	37.00	26.80	305	60	-138	3.1	11
6973	35.07	24.94	205	80	-20	3.1	4
5188	34.76	25.46	185	15	-60	3.1	7
6874	35.00	24.70	233	76	69	3.1	16
5352	35.04	25.92	50	45	-10	3.1	18
5774	35.07	26.04	70	85	0	3.1	18
5633	35.02	25.94	205	70	40	3.1	19
5775	35.07	26.11	85	80	60	3.1	22
6829	35.19	25.16	60	90	-180	3.1	27
6940	34.94	26.12	36	33	-28	3.1	38
5928	35.16	25.17	70	20	0	3.0	7
5817	35.04	24.57	143	14	-45	3.0	4
6964	35.06	25.89	40	40	-50	3.0	15
5354	35.04	26.10	100	65	50	3.0	17
5914	35.10	26.12	230	80	-30	3.0	22
2545	34.75	24.77	55	35	-70	2.9	24
6421	34.96	25.05	150	85	40	2.9	28
6965	35.06	25.92	5	30	-40	2.9	15
6975	35.07	25.87	55	50	0	2.9	15
6085	35.20	25.96	25	70	50	2.9	20
6697	34.91	25.40	75	7	45	2.9	4
6422	34.96	25.25	46	62	-66	2.9	11
5632	35.02	25.31	230	70	-180	2.8	27

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6877	35.00	25.25	75	30	50	2.8	5
4964	35.08	26.02	40	40	30	2.8	18
6974	35.07	25.73	89	30	82	2.7	7
6976	35.16	25.17	65	50	-40	2.7	2
5818	35.04	24.77	75	60	-110	2.7	4
4091	35.23	25.23	120	65	-11	2.7	4
4092	35.23	25.24	100	80	-30	2.7	4
6444	35.26	25.07	140	30	-139	2.7	8
6914	34.89	24.86	190	75	-139	2.7	36
6698	34.91	25.42	14	10	90	2.7	9
6924	34.91	25.46	100	40	5	2.7	9
5819	35.04	25.08	290	90	180	2.7	9
5782	35.08	25.88	58	51	13	2.7	15
6916	34.90	24.65	265	85	75	2.7	13
6963	35.06	25.77	125	54	89	2.6	13
6960	35.06	24.94	50	60	40	2.6	5
6442	35.25	25.24	55	45	-120	2.6	6
4801	34.88	25.43	127	18	-56	2.6	7
6943	34.95	25.25	221	55	64	2.6	10
6822	35.17	25.16	65	35	-10	2.5	5
6424	34.97	25.15	14	45	-40	2.5	11
6425	34.97	25.24	331	84	-55	2.5	11
6552	35.11	25.32	111	46	57	2.5	15
4234	35.93	24.89	18	55	-37	2.5	24
6959	35.06	24.93	260	60	-140	2.5	4
6923	34.91	25.43	280	35	48	2.5	1
5813	34.99	25.10	147	35	-42	2.5	7
5814	34.99	25.10	315	42	-54	2.5	7
6426	34.97	25.25	38	68	-79	2.5	10
6947	34.97	25.25	38	68	-79	2.5	10
6933	34.93	24.84	41	83	-20	2.5	35
6922	34.91	25.43	280	85	85	2.4	1
4796	34.86	24.68	223	80	24	2.4	38
6903	34.89	24.79	169	55	-30	2.3	32
6876	35.00	25.12	45	60	-110	2.3	4
6999	35.49	25.33	350	45	31	2.3	18
6945	34.95	25.56	160	75	80	2.3	9
5917	35.15	25.14	60	85	90	2.2	12
6949	34.98	25.27	314	77	-69	2.2	11
6944	34.95	25.26	160	75	80	2.1	9

Object ID	Latitude	Longitude	Strike (^{0})	Dip (^{0})	Rake (^{0})	M_w	Focal Depth (km)
6942	34.95	24.91	309	56	-72	2.1	10
6948	34.97	25.27	320	88	-75	2.1	10
5926	35.16	24.82	173	50	-14	2.1	12
6884	35.01	24.94	33	84	14	2.1	26
6927	34.92	24.89	55	78	-21	1.9	32

APPENDIX B - RANDOMLY GENERATED EARTHQUAKE SOURCE PARAMETERS USING MONTE CARLO SIMULATIONS

This appendix includes earthquake source parameters that used in this study to conduct tsunami simulations in the study area. $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$ are treated as independent parameters of the earthquake and through Monte Carlo simulations random values for these parameters are sampled from fitted distributions of $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$ that are generated using 523 historical earthquake data obtained from TRANSFER project. Different distributions are fitted to historical data and the goodness of fit of these distributions are tested using Kolmogorov-Smirnov test. Finally, normal and gamma distributions are selected as the best fitted distributions for $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$, respectively. The MATLAB codes used to fit a distribution and perform a goodness of fit test for $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$ are given as follows:

<u>For moment magnitude:</u>

```
pd=fitdist(Historical Magnitude,'Normal')
RandomMagnitudeNormal=normrnd(4.73113,1.04878,[1000,1]);
[h,p,ks2stat] = kstest2(Historical Magnitude,Random Magnitude Normal)
```

<u>For focal depth:</u>

```
pd=fitdist(Historical Focal Depth,'Gamma')
RandomFocalDepth=gamrnd(1.61392,20.1152,[1000,1]);
[h,p,ks2stat] = kstest2(Historical Focal Depth,Random Focal Depth)
```

Using Normal and Gamma distributions for $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$, respectively 1000 random earthquakes with 1000 random $\boldsymbol{M_w}$ and $\boldsymbol{Focal\ depth}$ values are generated and given in Table B.1. The rest of the earthquake source parameters given in Table B.1 are coming either directly from the randomly sampled earthquake from Thesis Earthquake Data Set (TEDS) (see Section 3.2.1) or calculated using empirical equations as explained in Section 3.3.2.

Table B.1 Randomly generated earthquake source parameters using Monte Carlo simulations

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
1	34.94	26.12	8.0	1.1E+28	11	265	56	2.45	36	33	-28
2	36.83	27.82	7.8	4.9E+27	38	186	44	2.00	63	27	-115
3	35.04	27.23	7.5	2.4E+27	36	134	36	1.66	56	67	10
4	36.88	27.70	7.5	1.8E+27	10	118	33	1.54	60	37	-112
5	35.04	32.27	7.4	1.6E+27	11	112	32	1.49	239	21	140
6	35.70	25.00	7.4	1.6E+27	8	111	31	1.49	238	29	33
7	35.40	27.90	7.4	1.5E+27	55	108	31	1.46	314	25	119
8	37.76	26.70	7.4	1.2E+27	23	100	29	1.40	231	75	-172
9	34.86	26.07	7.3	9.9E+26	14	91	27	1.32	5	35	120
10	34.76	25.46	7.3	8.6E+26	32	85	26	1.28	185	15	-60
11	35.10	26.60	7.2	6.1E+26	15	73	24	1.17	172	38	-106
12	33.80	25.62	7.1	5.2E+26	50	68	23	1.12	242	78	9
13	36.14	31.16	7.1	4.3E+26	21	62	21	1.07	70	79	-4
14	34.80	27.40	7.0	3.9E+26	10	60	21	1.04	34	67	157
15	34.75	25.74	7.0	3.5E+26	72	57	20	1.02	18	76	117
16	36.27	27.78	6.9	2.2E+26	11	46	18	0.90	342	70	161
17	35.50	26.40	6.8	2.1E+26	21	45	17	0.89	61	35	-40
18	34.90	32.20	6.8	2.0E+26	11	44	17	0.88	145	67	13
19	36.62	27.09	6.8	2.0E+26	38	44	17	0.87	315	44	173
20	35.24	27.36	6.8	1.9E+26	34	43	17	0.86	294	49	134
21	36.53	35.33	6.8	1.7E+26	5	41	16	0.85	50	85	10
22	34.23	25.25	6.8	1.7E+26	2	41	16	0.84	110	33	-83
23	37.77	26.89	6.8	1.7E+26	99	41	16	0.84	344	54	93
24	34.46	26.09	6.8	1.6E+26	26	40	16	0.83	306	33	116
25	35.30	31.20	6.7	1.5E+26	40	39	16	0.81	160	30	111
26	35.50	27.00	6.7	1.4E+26	26	37	15	0.80	325	70	90
27	36.00	30.00	6.7	1.3E+26	11	36	15	0.78	145	50	60
28	35.73	24.68	6.7	1.2E+26	12	35	15	0.77	240	80	25
29	33.74	35.19	6.7	1.1E+26	18	33	14	0.75	130	85	10
30	36.02	28.39	6.6	9.6E+25	70	32	14	0.73	10	34	-116

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
31	35.97	30.58	6.6	8.9E+25	16	31	13	0.71	21	45	-147
32	34.40	24.95	6.6	8.6E+25	16	30	13	0.71	163	50	44
33	34.35	26.16	6.6	8.3E+25	38	30	13	0.70	119	45	114
34	35.80	31.00	6.6	8.1E+25	11	30	13	0.70	50	75	150
35	36.70	26.30	6.6	8.1E+25	13	30	13	0.70	74	54	46
36	36.18	31.51	6.6	7.9E+25	59	29	13	0.69	67	23	-149
37	37.00	26.80	6.6	7.7E+25	92	29	13	0.69	305	60	-138
38	34.12	25.75	6.5	7.3E+25	43	28	13	0.68	305	44	124
39	36.35	29.39	6.5	7.2E+25	69	28	13	0.68	94	75	104
40	35.16	27.15	6.5	7.1E+25	26	28	13	0.68	234	77	4
41	34.75	24.77	6.5	6.7E+25	14	27	12	0.66	55	35	-70
42	34.40	24.50	6.5	6.5E+25	35	27	12	0.66	162	19	82
43	35.79	28.49	6.5	6.5E+25	29	27	12	0.66	78	61	-24
44	35.93	30.77	6.5	6.1E+25	26	26	12	0.65	165	70	50
45	32.90	29.80	6.5	5.9E+25	17	26	12	0.64	215	72	22
46	34.44	26.50	6.5	5.8E+25	19	25	12	0.64	184	46	-40
47	34.91	25.40	6.5	5.6E+25	11	25	12	0.63	75	7	45
48	35.82	24.97	6.5	5.5E+25	27	25	12	0.63	140	49	-90
49	37.63	26.72	6.5	5.5E+25	33	25	12	0.63	10	49	108
50	35.59	26.99	6.5	5.4E+25	46	25	12	0.63	310	44	98
51	34.76	25.81	6.5	5.4E+25	6	25	12	0.63	35	50	150
52	35.24	27.18	6.4	5.2E+25	39	24	11	0.62	216	39	-27
53	33.74	35.19	6.4	4.9E+25	10	24	11	0.61	130	85	10
54	34.7	26.3	6.4	4.6E+25	27	23	11	0.60	200	58	88
55	35.49	25.33	6.4	4.6E+25	33	23	11	0.60	350	45	31
56	34.42	26.38	6.4	4.5E+25	78	23	11	0.60	132	46	110
57	35.14	27.82	6.4	4.5E+25	3	23	11	0.60	248	65	-1
58	35.97	30.58	6.4	4.3E+25	10	22	11	0.59	21	45	-147
59	34.63	33.86	6.4	4.3E+25	15	22	11	0.59	70	35	50
60	34.3	32.5	6.3	3.6E+25	11	21	10	0.57	270	70	-160
61	34.9	26.3	6.3	3.3E+25	54	20	10	0.55	144	70	86
62	34.86	24.68	6.3	3.2E+25	45	20	10	0.55	223	80	24
63	35.04	27.23	6.3	3.2E+25	23	20	10	0.55	56	67	10

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
64	36.04	26.91	6.3	3.2E+25	107	19	10	0.55	213	38	-67
65	35.8	31.2	6.3	2.9E+25	22	19	10	0.54	80	20	-110
66	35.1	26.6	6.3	2.9E+25	11	19	10	0.53	214	52	-47
67	35.02	25.94	6.3	2.9E+25	88	19	10	0.53	205	70	40
68	34.81	25.39	6.3	2.7E+25	13	18	9	0.53	140	50	-119
69	34.64	25.5	6.3	2.7E+25	46	18	9	0.53	3	38	150
70	34.7	24.7	6.2	2.5E+25	43	18	9	0.52	320	80	-164
71	34.96	24.24	6.2	2.3E+25	23	17	9	0.51	216	11	10
72	36.36	26.95	6.2	2.3E+25	40	17	9	0.50	339	32	-177
73	34.89	24.79	6.2	2.3E+25	13	17	9	0.50	169	55	-30
74	35.49	25.33	6.2	2.0E+25	30	16	9	0.49	350	45	31
75	35.1	26.6	6.2	2.0E+25	29	16	9	0.48	214	52	-47
76	34.31	32.33	6.2	1.9E+25	23	16	9	0.48	97	76	-11
77	34.5	32.06	6.1	1.8E+25	25	15	8	0.47	62	48	-168
78	32.2	29.6	6.1	1.8E+25	51	15	8	0.47	315	59	36
79	35.16	27.17	6.1	1.7E+25	11	15	8	0.47	333	56	-157
80	36.05	27.76	6.1	1.7E+25	63	15	8	0.47	103	46	24
81	31.91	35.54	6.1	1.7E+25	13	15	8	0.46	25	80	93
82	36.5	35.7	6.1	1.7E+25	28	15	8	0.46	15	30	-60
83	35.4	27.9	6.1	1.6E+25	12	14	8	0.46	314	25	119
84	34.33	33.25	6.1	1.6E+25	29	14	8	0.46	335	27	133
85	35.7	30.6	6.1	1.6E+25	34	14	8	0.46	302	69	165
86	35.76	28.64	6.1	1.5E+25	69	14	8	0.45	342	73	177
87	34.36	26.03	6.1	1.4E+25	4	14	8	0.45	289	38	110
88	35.1	24.6	6.1	1.4E+25	15	14	8	0.44	240	65	34
89	34.2	25.8	6.1	1.4E+25	31	13	8	0.44	122	15	119
90	33.85	35.73	6.1	1.4E+25	0	13	8	0.44	110	55	-60
91	34.49	32.12	6.0	1.3E+25	19	13	8	0.44	125	12	-73
92	34.95	25.25	6.0	1.3E+25	37	13	8	0.44	221	55	64
93	34.9	27.4	6.0	1.3E+25	44	13	8	0.44	294	31	26
94	34.46	26.09	6.0	1.3E+25	9	13	8	0.43	306	33	116
95	32.9	29.8	6.0	1.2E+25	38	13	7	0.43	215	72	22
96	35.31	27.38	6.0	1.2E+25	10	13	7	0.43	150	80	0

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike $(^0)$	Dip $(^0)$	Rake $(^0)$
97	33.74	35.46	6.0	1.2E+25	34	13	7	0.43	87	43	-178
98	36.77	28.13	6.0	1.2E+25	50	12	7	0.42	316	54	137
99	36	30	6.0	1.2E+25	21	12	7	0.42	145	50	60
100	34.1	35.5	6.0	1.1E+25	101	12	7	0.42	200	70	-27
101	34.23	25.25	6.0	1.1E+25	28	12	7	0.42	110	33	-83
102	37.26	26.89	6.0	1.1E+25	39	12	7	0.42	70	40	-90
103	34.75	24.77	6.0	1.0E+25	32	12	7	0.41	55	35	-70
104	36.1	26.8	6.0	1.0E+25	53	12	7	0.41	275	85	-174
105	34.4	24.5	6.0	1.0E+25	72	12	7	0.41	162	19	82
106	35.81	29.75	6.0	1.0E+25	2	12	7	0.41	207	39	-34
107	32.2	29.5	6.0	1.0E+25	10	12	7	0.41	35	25	90
108	35.5	25.5	6.0	1.0E+25	18	12	7	0.41	130	75	90
109	34.3	26.17	6.0	9.9E+24	32	12	7	0.41	8	40	-159
110	35	24.7	6.0	9.7E+24	13	11	7	0.40	233	76	69
111	31.96	35.574	6.0	9.6E+24	48	11	7	0.40	90	74	168
112	35.04	32.31	6.0	9.5E+24	5	11	7	0.40	71	34	-9
113	35.24	27.12	5.9	9.3E+24	31	11	7	0.40	5	10	8
114	36.7	26.3	5.9	9.2E+24	44	11	7	0.40	74	54	46
115	35.04	32.27	5.9	9.2E+24	21	11	7	0.40	239	21	140
116	33.65	25.501	5.9	9.1E+24	38	11	7	0.40	345	85	-179
117	34.95	25.25	5.9	9.0E+24	8	11	7	0.40	221	55	64
118	34.53	33.6	5.9	9.0E+24	29	11	7	0.40	280	70	-160
119	35.93	30.77	5.9	8.9E+24	25	11	7	0.40	165	70	50
120	34.86	26.07	5.9	8.8E+24	42	11	7	0.39	5	35	120
121	35.24	26.01	5.9	8.8E+24	49	11	7	0.39	15	55	80
122	37.31	24.67	5.9	8.6E+24	26	11	7	0.39	256	50	16
123	35.71	29.3	5.9	7.9E+24	10	10	7	0.38	192	25	-43
124	35.5	25.5	5.9	7.8E+24	9	10	7	0.38	130	75	90
125	34.53	24.38	5.9	7.8E+24	21	10	7	0.38	30	37	71
126	34.59	26.19	5.9	7.7E+24	35	10	7	0.38	23	50	-151
127	37.25	26.87	5.9	7.6E+24	53	10	6	0.38	260	49	-98
128	35.2	27.7	5.9	7.3E+24	19	10	6	0.38	200	69	4
129	34.4	32.11	5.9	7.1E+24	33	10	6	0.37	324	73	-17

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
130	36.8	26.4	5.9	7.1E+24	25	10	6	0.37	231	84	-180
131	36.48	28.11	5.9	7.1E+24	37	10	6	0.37	117	40	85
132	36.41	31.75	5.9	7.0E+24	27	10	6	0.37	48	27	-133
133	35.04	25.08	5.9	6.9E+24	33	10	6	0.37	290	90	180
134	35.29	28.67	5.9	6.8E+24	22	10	6	0.37	25	32	-152
135	34.81	27.2	5.8	6.5E+24	23	10	6	0.37	40	70	2
136	34.4	32.5	5.8	6.5E+24	36	10	6	0.37	250	60	-170
137	36.62	24.55	5.8	6.5E+24	6	10	6	0.36	105	36	-81
138	36.3	26.7	5.8	6.3E+24	43	9	6	0.36	278	86	-176
139	35.1	24.6	5.8	6.2E+24	3	9	6	0.36	240	65	34
140	36.69	26.96	5.8	6.2E+24	14	9	6	0.36	312	46	162
141	36.5	28.6	5.8	6.1E+24	6	9	6	0.36	304	58	-175
142	35.81	29.75	5.8	6.0E+24	32	9	6	0.36	207	39	-34
143	35.87	36.28	5.8	6.0E+24	38	9	6	0.36	295	85	-2
144	35.31	27.38	5.8	5.9E+24	21	9	6	0.36	150	80	0
145	36.15	27.2	5.8	5.8E+24	38	9	6	0.35	130	40	-148
146	31.6	30.2	5.8	5.7E+24	37	9	6	0.35	307	7	-110
147	36.7	35.88	5.8	5.6E+24	14	9	6	0.35	204	28	-93
148	36.4	28.6	5.8	5.6E+24	80	9	6	0.35	114	29	28
149	34.95	25.26	5.8	5.5E+24	30	9	6	0.35	160	75	80
150	35.08	26.52	5.8	5.3E+24	21	9	6	0.35	105	72	-177
151	34.73	25.82	5.8	5.3E+24	34	9	6	0.35	24	58	-42
152	35.4	25.9	5.8	5.0E+24	59	9	6	0.34	7	16	114
153	36.3	26.7	5.8	4.9E+24	17	8	6	0.34	279	89	179
154	35.2	27.12	5.8	4.9E+24	24	8	6	0.34	244	57	-5
155	35.5	27	5.7	4.6E+24	37	8	6	0.34	325	70	90
156	34.37	26.35	5.7	4.6E+24	11	8	6	0.33	284	53	38
157	36.83	27.83	5.7	4.6E+24	48	8	6	0.33	68	36	-100
158	34.4	24.5	5.7	4.5E+24	44	8	6	0.33	162	19	82
159	36.15	27.51	5.7	4.5E+24	52	8	6	0.33	184	70	-90
160	36.4	27.3	5.7	4.4E+24	80	8	6	0.33	8	22	-154
161	36.15	27.1	5.7	4.4E+24	28	8	6	0.33	196	38	-102
162	34.51	26.59	5.7	4.3E+24	18	8	5	0.33	227	37	23

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
163	36.6	27	5.7	4.3E+24	64	8	5	0.33	140	82	30
164	36.24	31.34	5.7	4.2E+24	68	8	5	0.33	132	64	155
165	33.75	28.5	5.7	4.1E+24	16	8	5	0.33	220	45	90
166	36.5	28.6	5.7	4.1E+24	14	8	5	0.32	58	85	19
167	35.8	29.7	5.7	4.1E+24	76	8	5	0.32	216	40	-13
168	35.79	28.49	5.7	4.1E+24	16	8	5	0.32	78	61	-24
169	37.26	26.89	5.7	4.1E+24	21	8	5	0.32	70	40	-90
170	34.91	25.43	5.7	4.0E+24	-	8	5	0.32	280	35	48
171	36.5	35.7	5.7	4.0E+24	17	8	5	0.32	15	30	-60
172	35.06	26.41	5.7	4.0E+24	11	8	5	0.32	78	64	-21
173	35.04	26.1	5.7	4.0E+24	16	8	5	0.32	100	65	50
174	36.7	27.4	5.7	3.9E+24	8	8	5	0.32	60	45	-90
175	34.74	34.41	5.7	3.9E+24	20	8	5	0.32	343	27	133
176	34.39	28.3	5.7	3.8E+24	5	8	5	0.32	67	48	-34
177	34.92	25.179	5.7	3.8E+24	36	8	5	0.32	173	47	-144
178	34.59	32.21	5.7	3.7E+24	30	7	5	0.32	56	68	175
179	35.3	31.2	5.7	3.6E+24	48	7	5	0.32	160	30	111
180	34.5	25.6	5.7	3.6E+24	125	7	5	0.31	133	21	115
181	34.85	25.36	5.7	3.6E+24	36	7	5	0.31	248	61	1
182	36.4	28.6	5.7	3.5E+24	10	7	5	0.31	114	29	28
183	35.75	25	5.7	3.4E+24	104	7	5	0.31	270	69	112
184	35.3	31.2	5.7	3.4E+24	25	7	5	0.31	160	30	111
185	34.91	25.4	5.7	3.4E+24	20	7	5	0.31	75	7	45
186	35.04	32.31	5.6	3.3E+24	18	7	5	0.31	71	34	-9
187	35.06	32.26	5.6	3.3E+24	10	7	5	0.31	224	20	133
188	33.6	27.5	5.6	3.3E+24	15	7	5	0.31	42	59	-169
189	36.79	34.35	5.6	3.2E+24	32	7	5	0.31	26	15	-95
190	36.99	26.81	5.6	3.2E+24	23	7	5	0.30	88	51	-69
191	35.04	26.1	5.6	3.2E+24	66	7	5	0.30	100	65	50
192	36.63	31.41	5.6	3.1E+24	27	7	5	0.30	188	37	6
193	34.56	32.13	5.6	3.0E+24	38	7	5	0.30	48	77	170
194	35.69	25.71	5.6	3.0E+24	115	7	5	0.30	157	49	-108
195	35.04	25.92	5.6	3.0E+24	52	7	5	0.30	50	45	-10

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
196	34.4	24.95	5.6	3.0E+24	15	7	5	0.30	163	50	44
197	34.96	25.25	5.6	2.9E+24	93	7	5	0.30	46	62	-66
198	35.27	27.12	5.6	2.9E+24	14	7	5	0.30	234	41	-23
199	34.51	26.59	5.6	2.8E+24	29	7	5	0.30	135	76	13
200	33.7	35.5	5.6	2.8E+24	40	7	5	0.29	160	75	-40
201	35	27.1	5.6	2.8E+24	10	7	5	0.29	188	31	-21
202	35	33.9	5.6	2.8E+24	7	7	5	0.29	95	45	110
203	32.2	29.6	5.6	2.7E+24	35	6	5	0.29	315	59	36
204	33.75	28.5	5.6	2.7E+24	10	6	5	0.29	220	45	90
205	34.6	32.8	5.6	2.7E+24	86	6	5	0.29	95	45	110
206	36.07	27.34	5.6	2.6E+24	35	6	5	0.29	235	67	24
207	36.5	35.7	5.6	2.6E+24	30	6	5	0.29	15	30	-60
208	35.1	26.6	5.6	2.6E+24	5	6	5	0.29	172	38	-106
209	34.49	32.12	5.6	2.5E+24	2	6	5	0.29	125	12	-73
210	36.1	27.4	5.6	2.5E+24	47	6	5	0.29	350	30	142
211	34.49	32.12	5.6	2.5E+24	22	6	5	0.29	40	64	162
212	36.83	27.83	5.6	2.5E+24	8	6	5	0.29	68	36	-100
213	35.2	26.7	5.6	2.5E+24	81	6	5	0.28	306	78	-90
214	34.49	32.071	5.6	2.4E+24	7	6	5	0.28	44	86	-173
215	35.4	26.417	5.5	2.3E+24	6	6	5	0.28	31	70	101
216	36.3	27.5	5.5	2.3E+24	47	6	5	0.28	246	21	-11
217	36.02	28.39	5.5	2.3E+24	19	6	5	0.28	10	34	-116
218	35.1	26.6	5.5	2.3E+24	101	6	5	0.28	214	52	-47
219	34.8	27.4	5.5	2.3E+24	18	6	5	0.28	34	67	157
220	35.19	27.54	5.5	2.3E+24	20	6	5	0.28	62	75	12
221	35.01	24.68	5.5	2.2E+24	20	6	4	0.28	279	55	-35
222	35	24.7	5.5	2.2E+24	32	6	4	0.28	233	76	69
223	36.08	26.475	5.5	2.1E+24	48	6	4	0.27	328	64	-169
224	34.53	24.94	5.5	2.1E+24	59	6	4	0.27	176	78	-171
225	36.56	30.71	5.5	2.1E+24	43	6	4	0.27	178	30	4
226	34.44	26.497	5.5	2.1E+24	7	6	4	0.27	184	46	-40
227	35.73	24.68	5.5	2.1E+24	3	6	4	0.27	240	80	25
228	34.12	25.75	5.5	2.1E+24	26	6	4	0.27	305	44	124

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
229	35.12	27.81	5.5	2.0E+24	3	6	4	0.27	1	39	-146
230	33.8	25.62	5.5	2.0E+24	20	6	4	0.27	242	78	9
231	34.62	33.7	5.5	2.0E+24	7	6	4	0.27	110	45	70
232	35.71	29.3	5.5	2.0E+24	20	6	4	0.27	192	25	-43
233	34.4	32.29	5.5	2.0E+24	22	6	4	0.27	55	35	177
234	36.35	29.39	5.5	1.9E+24	18	6	4	0.27	94	75	104
235	34.91	25.43	5.5	1.9E+24	33	6	4	0.27	280	85	85
236	35.05	26.11	5.5	1.9E+24	17	6	4	0.27	40	90	175
237	34.19	25.8	5.5	1.9E+24	5	6	4	0.27	262	40	102
238	37.31	24.67	5.5	1.9E+24	42	6	4	0.27	256	50	16
239	36.62	27.09	5.5	1.9E+24	47	6	4	0.27	315	44	173
240	34.14	25.72	5.5	1.9E+24	35	6	4	0.27	58	51	42
241	37.63	26.72	5.5	1.9E+24	78	5	4	0.26	10	49	108
242	34.48	32.13	5.5	1.8E+24	37	5	4	0.26	14	53	165
243	36.02	28.39	5.5	1.8E+24	7	5	4	0.26	10	34	-116
244	36.36	26.95	5.5	1.8E+24	34	5	4	0.26	339	32	-177
245	34.9	27.4	5.5	1.8E+24	38	5	4	0.26	56	67	-168
246	34.4	25.2	5.5	1.7E+24	28	5	4	0.26	120	63	90
247	34.72	32.88	5.5	1.7E+24	26	5	4	0.26	240	85	70
248	34.9	26.9	5.5	1.7E+24	26	5	4	0.26	227	44	7
249	33.74	35.19	5.5	1.7E+24	24	5	4	0.26	130	85	10
250	34.4	26.1	5.4	1.7E+24	16	5	4	0.26	151	70	144
251	36.13	27.52	5.4	1.6E+24	54	5	4	0.26	170	32	-62
252	32.75	24.37	5.4	1.6E+24	10	5	4	0.25	326	40	-7
253	34.53	24.38	5.4	1.6E+24	32	5	4	0.25	30	37	71
254	36.8	26.4	5.4	1.6E+24	26	5	4	0.25	231	84	-180
255	35.1	30.54	5.4	1.6E+24	29	5	4	0.25	265	68	-171
256	34.81	25.81	5.4	1.5E+24	13	5	4	0.25	40	50	140
257	34.38	26.23	5.4	1.5E+24	55	5	4	0.25	219	38	30
258	34.91	25.4	5.4	1.4E+24	73	5	4	0.25	75	7	45
259	34.9	26.3	5.4	1.4E+24	14	5	4	0.25	144	70	86
260	35.93	30.77	5.4	1.4E+24	73	5	4	0.25	165	70	50
261	34.8	33.67	5.4	1.4E+24	31	5	4	0.25	241	60	132

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
262	34.56	32.13	5.4	1.4E+24	26	5	4	0.24	48	77	170
263	36.9	27.9	5.4	1.4E+24	6	5	4	0.24	83	36	-103
264	36.72	27.505	5.4	1.3E+24	44	5	4	0.24	193	65	162
265	34.56	32.21	5.4	1.3E+24	21	5	4	0.24	139	53	12
266	36.7	27.4	5.4	1.3E+24	28	5	4	0.24	60	45	-90
267	32.75	24.37	5.4	1.3E+24	122	5	4	0.24	326	40	-7
268	34.96	25.25	5.4	1.3E+24	22	5	4	0.24	46	62	-66
269	34.58	24.77	5.4	1.3E+24	14	5	4	0.24	47	34	-115
270	34.96	25.25	5.4	1.3E+24	43	5	4	0.24	46	62	-66
271	36.25	28.28	5.4	1.2E+24	61	5	4	0.24	38	55	170
272	36.99	26.8	5.4	1.2E+24	24	5	4	0.24	109	41	-70
273	34.88	25.75	5.4	1.2E+24	14	5	4	0.24	40	49	-90
274	34.85	25.06	5.4	1.2E+24	48	5	4	0.24	256	65	-11
275	34.49	32.12	5.4	1.2E+24	87	5	4	0.24	40	64	162
276	35.24	27.18	5.4	1.2E+24	33	5	4	0.24	216	39	-27
277	35.14	27.82	5.4	1.2E+24	38	5	4	0.24	248	65	-1
278	34.84	25.8	5.3	1.2E+24	9	4	4	0.24	180	41	-96
279	35.55	28.16	5.3	1.2E+24	35	4	4	0.24	348	67	-179
280	35.87	36.28	5.3	1.2E+24	18	4	4	0.24	295	85	-2
281	35.65	26.18	5.3	1.2E+24	31	4	4	0.24	93	20	-94
282	36.18	31.51	5.3	1.2E+24	7	4	4	0.24	67	23	-149
283	34.44	26.51	5.3	1.2E+24	18	4	4	0.24	309	74	-177
284	34.9	32.26	5.3	1.1E+24	3	4	4	0.23	340	55	130
285	34.01	25.88	5.3	1.1E+24	9	4	4	0.23	138	80	178
286	35.04	24.77	5.3	1.1E+24	92	4	4	0.23	75	60	-110
287	34.3	26.1	5.3	1.1E+24	11	4	4	0.23	103	8	-68
288	35.55	35.25	5.3	1.1E+24	101	4	4	0.23	163	77	-105
289	36.11	27.21	5.3	1.1E+24	88	4	4	0.23	0	40	-114
290	36.63	24.27	5.3	1.0E+24	27	4	4	0.23	258	80	177
291	36.32	28.27	5.3	1.0E+24	87	4	4	0.23	315	41	-93
292	35.59	26.99	5.3	1.0E+24	14	4	4	0.23	310	44	98
293	34.64	25.59	5.3	9.9E+23	10	4	4	0.23	77	10	-118
294	36.1	27.4	5.3	9.8E+23	79	4	4	0.23	350	30	142

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
295	37.84	26.81	5.3	9.8E+23	12	4	4	0.22	271	49	-132
296	34.4	32.29	5.3	9.7E+23	13	4	4	0.22	55	35	177
297	34.9	27.4	5.3	9.6E+23	48	4	4	0.22	54	70	176
298	35	27.48	5.3	9.5E+23	26	4	4	0.22	214	60	-34
299	35.16	27.17	5.3	9.5E+23	66	4	4	0.22	333	56	-157
300	35.04	24.77	5.3	9.4E+23	22	4	3	0.22	75	60	-110
301	34.4	24.5	5.3	9.3E+23	23	4	3	0.22	162	19	82
302	35.04	27.43	5.3	9.3E+23	14	4	3	0.22	323	73	162
303	35.7	30.8	5.3	9.3E+23	37	4	3	0.22	30	70	170
304	34.9	32.2	5.3	9.2E+23	33	4	3	0.22	145	67	13
305	34.7	26.3	5.3	9.1E+23	56	4	3	0.22	200	58	88
306	36.7	35.88	5.3	9.1E+23	24	4	3	0.22	204	28	-93
307	36.18	31.51	5.3	9.1E+23	31	4	3	0.22	150	75	90
308	35.79	26.62	5.3	9.0E+23	19	4	3	0.22	18	35	-163
309	34.3	26.1	5.3	8.9E+23	75	4	3	0.22	103	8	-68
310	34.94	26.12	5.3	8.9E+23	106	4	3	0.22	36	33	-28
311	35.23	30.82	5.3	8.9E+23	26	4	3	0.22	127	11	87
312	35.07	26.71	5.3	8.8E+23	83	4	3	0.22	172	38	-106
313	35.2	35.6	5.3	8.8E+23	19	4	3	0.22	259	69	0
314	34.88	25.75	5.3	8.6E+23	43	4	3	0.22	40	49	-90
315	34.9	24.65	5.3	8.6E+23	2	4	3	0.22	265	85	75
316	35.07	26.11	5.3	8.6E+23	28	4	3	0.22	85	80	60
317	35.82	24.97	5.3	8.5E+23	18	4	3	0.22	140	49	-90
318	34.42	26.38	5.3	8.4E+23	16	4	3	0.22	132	46	110
319	34.75	25.74	5.2	8.4E+23	48	4	3	0.22	18	76	117
320	35.34	27.47	5.2	8.1E+23	10	4	3	0.21	309	32	98
321	36.04	26.91	5.2	8.1E+23	35	4	3	0.21	213	38	-67
322	34.42	26.57	5.2	8.1E+23	42	4	3	0.21	107	76	169
323	34.93	24.84	5.2	8.0E+23	49	4	3	0.21	41	83	-20
324	34.95	24.91	5.2	7.9E+23	19	4	3	0.21	309	56	-72
325	34.4	24.5	5.2	7.8E+23	63	4	3	0.21	268	75	-163
326	36.89	27.85	5.2	7.7E+23	23	4	3	0.21	71	31	-99
327	35.1	26.6	5.2	7.6E+23	32	4	3	0.21	214	52	-47

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
328	36.69	25.74	5.2	7.6E+23	27	4	3	0.21	280	70	-47
329	35.14	27.82	5.2	7.5E+23	11	4	3	0.21	248	65	-1
330	36.25	28.28	5.2	7.5E+23	26	4	3	0.21	38	55	170
331	34.22	25.69	5.2	7.3E+23	8	4	3	0.21	276	43	80
332	34.92	26.26	5.2	7.1E+23	9	4	3	0.21	223	19	33
333	36.11	27.21	5.2	7.1E+23	68	4	3	0.21	0	40	-114
334	35.06	32.26	5.2	7.0E+23	26	4	3	0.21	224	20	133
335	34.75	33.04	5.2	7.0E+23	15	4	3	0.21	92	64	67
336	34.77	26.37	5.2	6.9E+23	52	4	3	0.21	252	22	1
337	37.27	26.88	5.2	6.7E+23	19	3	3	0.20	99	49	-77
338	34.75	33.04	5.2	6.6E+23	137	3	3	0.20	92	64	67
339	35.07	24.317	5.2	6.6E+23	55	3	3	0.20	311	66	47
340	35.55	35.25	5.2	6.4E+23	66	3	3	0.20	163	77	-105
341	35.4	27.9	5.2	6.4E+23	73	3	3	0.20	314	25	119
342	34.58	24.77	5.2	6.3E+23	10	3	3	0.20	47	34	-115
343	34.7	24.7	5.2	6.2E+23	42	3	3	0.20	320	80	-164
344	36.2	28.9	5.2	6.1E+23	9	3	3	0.20	193	24	3
345	35.04	25.92	5.2	6.0E+23	34	3	3	0.20	50	45	-10
346	34.67	24.88	5.2	6.0E+23	10	3	3	0.20	180	40	60
347	35.24	27.36	5.2	6.0E+23	25	3	3	0.20	294	49	134
348	31.91	35.54	5.1	5.9E+23	10	3	3	0.20	25	80	93
349	33.74	35.19	5.1	5.8E+23	45	3	3	0.20	130	85	10
350	34.2	25.8	5.1	5.8E+23	28	3	3	0.20	122	15	119
351	35.1	26.6	5.1	5.7E+23	9	3	3	0.20	214	52	-47
352	37	26.79	5.1	5.6E+23	18	3	3	0.19	20	49	-41
353	35.24	27.18	5.1	5.5E+23	30	3	3	0.19	216	39	-27
354	36.63	31.41	5.1	5.5E+23	16	3	3	0.19	188	37	6
355	36.48	28.11	5.1	5.5E+23	110	3	3	0.19	117	40	85
356	36.23	28.45	5.1	5.4E+23	14	3	3	0.19	11	26	-57
357	34.59	32.21	5.1	5.3E+23	21	3	3	0.19	56	68	175
358	35.7	30.8	5.1	5.3E+23	94	3	3	0.19	30	70	170
359	34.79	24.15	5.1	5.2E+23	7	3	3	0.19	319	6	123
360	34.91	24.8	5.1	5.1E+23	5	3	3	0.19	142	22	-35

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
361	34.4	32.5	5.1	5.1E+23	22	3	3	0.19	250	60	-170
362	34.37	26.35	5.1	5.0E+23	35	3	3	0.19	284	53	38
363	34.63	33.86	5.1	5.0E+23	11	3	3	0.19	70	35	50
364	37.76	26.7	5.1	5.0E+23	23	3	3	0.19	231	75	-172
365	35.65	29.8	5.1	5.0E+23	37	3	3	0.19	104	8	-72
366	35.93	24.89	5.1	4.9E+23	51	3	3	0.19	18	55	-37
367	36.83	27.83	5.1	4.8E+23	8	3	3	0.19	68	36	-100
368	36.16	28.14	5.1	4.8E+23	50	3	3	0.19	130	49	97
369	35.5	26.4	5.1	4.8E+23	19	3	3	0.19	61	35	-40
370	35.65	29.8	5.1	4.7E+23	11	3	3	0.19	104	8	-72
371	34.81	27.28	5.1	4.7E+23	21	3	3	0.19	255	74	-17
372	35.2	26.7	5.1	4.7E+23	16	3	3	0.19	306	78	-90
373	34.86	24.68	5.1	4.7E+23	20	3	3	0.19	223	80	24
374	36.17	31.81	5.1	4.7E+23	16	3	3	0.19	65	20	-90
375	34.8	24.7	5.1	4.7E+23	36	3	3	0.19	264	61	44
376	36.32	28.27	5.1	4.6E+23	12	3	3	0.19	315	41	-93
377	34.53	33.6	5.1	4.6E+23	51	3	3	0.18	280	70	-160
378	36.07	27.46	5.1	4.5E+23	6	3	3	0.18	9	53	-114
379	36.9	27.9	5.1	4.5E+23	14	3	3	0.18	83	36	-103
380	34.9	32.26	5.1	4.5E+23	5	3	3	0.18	340	55	130
381	34.1	32.4	5.1	4.4E+23	23	3	3	0.18	95	75	-30
382	35.78	29.7	5.1	4.4E+23	11	3	3	0.18	207	75	8
383	34.23	25.25	5.1	4.4E+23	173	3	3	0.18	110	33	-83
384	34.22	25.69	5.1	4.4E+23	18	3	3	0.18	276	43	80
385	35.01	24.68	5.1	4.3E+23	35	3	3	0.18	279	55	-35
386	34.51	26.65	5.1	4.3E+23	15	3	3	0.18	15	55	-11
387	36.53	35.33	5.0	4.2E+23	3	3	3	0.18	50	85	10
388	36.4	27.3	5.0	4.2E+23	51	3	3	0.18	8	22	-154
389	34.75	24.77	5.0	4.2E+23	4	3	3	0.18	55	35	-70
390	34.9	27.4	5.0	4.2E+23	30	3	3	0.18	54	70	176
391	34.4	24.2	5.0	4.1E+23	36	3	3	0.18	296	59	47
392	34.91	25.4	5.0	4.1E+23	20	3	3	0.18	75	7	45
393	36.67	28.03	5.0	4.0E+23	2	3	3	0.18	239	29	-105

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
394	36.13	27.52	5.0	4.0E+23	2	3	3	0.18	170	32	-62
395	34.91	24.719	5.0	4.0E+23	20	3	3	0.18	321	89	-3
396	36.79	34.35	5.0	4.0E+23	16	3	3	0.18	26	15	-95
397	36.3	27.5	5.0	3.8E+23	26	3	3	0.18	246	21	-11
398	34.4	26.1	5.0	3.8E+23	17	3	3	0.18	151	70	144
399	37.25	26.87	5.0	3.7E+23	64	3	3	0.18	260	49	-98
400	35.76	28.64	5.0	3.7E+23	13	3	3	0.18	342	73	177
401	35.07	26.04	5.0	3.7E+23	35	3	3	0.18	70	85	0
402	34.94	26.12	5.0	3.7E+23	43	3	3	0.18	36	33	-28
403	34.9	27.4	5.0	3.7E+23	8	3	3	0.17	56	67	-168
404	37.84	26.81	5.0	3.6E+23	36	3	3	0.17	271	49	-132
405	34.4	25.2	5.0	3.6E+23	2	3	3	0.17	120	63	90
406	34.6	26.3	5.0	3.5E+23	66	3	3	0.17	143	69	85
407	34.82	24.28	5.0	3.5E+23	15	3	3	0.17	235	39	-8
408	34.94	26.1	5.0	3.5E+23	9	3	3	0.17	90	65	-170
409	34.56	32.21	5.0	3.4E+23	32	3	3	0.17	139	53	12
410	35.16	27.15	5.0	3.4E+23	53	3	3	0.17	234	77	4
411	36.4	27.7	5.0	3.4E+23	44	3	3	0.17	194	67	167
412	34.72	32.88	5.0	3.4E+23	6	3	3	0.17	240	85	70
413	36.88	27.7	5.0	3.4E+23	75	3	3	0.17	60	37	-112
414	37.76	26.7	5.0	3.4E+23	1	3	3	0.17	231	75	-172
415	34.85	25.06	5.0	3.4E+23	24	3	3	0.17	256	65	-11
416	36.4	27.7	5.0	3.3E+23	55	3	3	0.17	194	67	167
417	36.5	28.6	5.0	3.3E+23	17	3	3	0.17	304	58	-175
418	34.4	24.5	5.0	3.2E+23	30	3	3	0.17	127	25	51
419	35.95	27.42	5.0	3.2E+23	27	2	3	0.17	53	19	-129
420	34.49	32.12	5.0	3.2E+23	65	2	3	0.17	48	77	170
421	35.5	25.76	5.0	3.2E+23	17	2	3	0.17	192	41	-73
422	32.2	29.5	5.0	3.1E+23	35	2	3	0.17	35	25	90
423	36.7	25.8	5.0	3.1E+23	34	2	3	0.17	65	45	-90
424	36.83	27.82	4.9	3.0E+23	12	2	2	0.17	63	27	-115
425	36.6	27	4.9	3.0E+23	92	2	2	0.17	140	82	30
426	33.8	25.62	4.9	2.9E+23	22	2	2	0.17	242	78	9

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
427	35.05	26.11	4.9	2.8E+23	53	2	2	0.16	70	71	16
428	35.1	26.6	4.9	2.8E+23	27	2	2	0.16	172	38	-106
429	34.56	32.21	4.9	2.8E+23	44	2	2	0.16	139	53	12
430	34.3	26.17	4.9	2.8E+23	1	2	2	0.16	8	40	-159
431	34.59	26.19	4.9	2.8E+23	55	2	2	0.16	23	50	-151
432	36.6	26.9	4.9	2.8E+23	52	2	2	0.16	315	50	164
433	32.9	29.8	4.9	2.8E+23	66	2	2	0.16	215	72	22
434	36.79	27.826	4.9	2.7E+23	11	2	2	0.16	73	34	-99
435	35.29	28.67	4.9	2.7E+23	14	2	2	0.16	25	32	-152
436	34.63	28.36	4.9	2.7E+23	65	2	2	0.16	99	37	-53
437	35.04	24.57	4.9	2.7E+23	20	2	2	0.16	143	14	-45
438	34.91	25.43	4.9	2.6E+23	44	2	2	0.16	280	85	85
439	35.1	26.6	4.9	2.6E+23	23	2	2	0.16	172	38	-106
440	35.07	26.11	4.9	2.6E+23	53	2	2	0.16	85	80	60
441	34.77	25.82	4.9	2.6E+23	39	2	2	0.16	54	58	-42
442	35.4	27.62	4.9	2.5E+23	26	2	2	0.16	212	45	-29
443	34.38	26.23	4.9	2.5E+23	24	2	2	0.16	219	38	30
444	37.76	26.7	4.9	2.5E+23	16	2	2	0.16	231	75	-172
445	34.5	25.1	4.9	2.5E+23	94	2	2	0.16	286	75	-107
446	34.91	25.42	4.9	2.5E+23	24	2	2	0.16	14	10	90
447	34.64	25.5	4.9	2.4E+23	16	2	2	0.16	3	38	150
448	34.98	26.25	4.9	2.4E+23	25	2	2	0.16	268	78	-1
449	33.6	27.5	4.9	2.4E+23	66	2	2	0.16	42	59	-169
450	34.53	24.38	4.9	2.4E+23	27	2	2	0.16	30	37	71
451	35	24.22	4.9	2.4E+23	3	2	2	0.16	314	73	-174
452	35.04	26.12	4.9	2.4E+23	8	2	2	0.16	240	85	-60
453	34.81	27.28	4.9	2.3E+23	32	2	2	0.16	255	74	-17
454	35.1	26.6	4.9	2.3E+23	11	2	2	0.16	172	38	-106
455	35.2	26.7	4.9	2.3E+23	75	2	2	0.15	306	78	-90
456	35.92	27.18	4.9	2.3E+23	9	2	2	0.15	347	35	-111
457	35.6	24.5	4.9	2.2E+23	43	2	2	0.15	191	65	-79
458	34.14	25.72	4.9	2.1E+23	11	2	2	0.15	58	51	42
459	35.16	27.17	4.8	2.1E+23	31	2	2	0.15	333	56	-157

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
460	36.3	26.7	4.8	2.1E+23	8	2	2	0.15	278	86	-176
461	36.5	28.6	4.8	2.1E+23	26	2	2	0.15	304	58	-175
462	36.67	28.03	4.8	2.1E+23	14	2	2	0.15	239	29	-105
463	35	26.5	4.8	2.0E+23	11	2	2	0.15	264	41	16
464	34.4	32.11	4.8	2.0E+23	67	2	2	0.15	324	73	-17
465	34.8	33.67	4.8	2.0E+23	3	2	2	0.15	241	60	132
466	36.4	27.7	4.8	2.0E+23	58	2	2	0.15	194	67	167
467	35.07	24.317	4.8	2.0E+23	91	2	2	0.15	311	66	47
468	35.93	24.89	4.8	1.9E+23	12	2	2	0.15	18	55	-37
469	35.48	26.32	4.8	1.9E+23	62	2	2	0.15	61	35	-40
470	34.84	25.8	4.8	1.9E+23	36	2	2	0.15	180	41	-96
471	35.5	25.76	4.8	1.9E+23	15	2	2	0.15	192	41	-73
472	35.5	27	4.8	1.9E+23	6	2	2	0.15	190	62	-90
473	35.86	25.96	4.8	1.8E+23	40	2	2	0.15	225	73	-160
474	34.71	33.5	4.8	1.8E+23	43	2	2	0.15	145	25	110
475	36.03	32.32	4.8	1.8E+23	19	2	2	0.15	326	75	-173
476	36.99	26.81	4.8	1.8E+23	27	2	2	0.15	88	51	-69
477	34.16	26.16	4.8	1.7E+23	61	2	2	0.14	104	77	173
478	34.92	26.75	4.8	1.7E+23	54	2	2	0.14	129	27	-106
479	35.1	27.2	4.8	1.7E+23	23	2	2	0.14	149	81	8
480	34.74	24.85	4.8	1.6E+23	40	2	2	0.14	125	3	-64
481	34.12	25.75	4.8	1.6E+23	51	2	2	0.14	305	44	124
482	35.23	30.82	4.8	1.6E+23	78	2	2	0.14	127	11	87
483	34.49	32.72	4.8	1.6E+23	64	2	2	0.14	125	50	131
484	34.4	32.5	4.8	1.6E+23	48	2	2	0.14	250	60	-170
485	36.15	27.1	4.8	1.6E+23	79	2	2	0.14	196	38	-102
486	35.58	24.72	4.8	1.6E+23	31	2	2	0.14	177	63	22
487	36.15	27.51	4.8	1.5E+23	7	2	2	0.14	184	70	-90
488	36.48	28.11	4.8	1.5E+23	34	2	2	0.14	117	40	85
489	35.65	25.99	4.8	1.5E+23	29	2	2	0.14	179	57	-68
490	35.74	27.83	4.8	1.5E+23	32	2	2	0.14	349	45	-76
491	36.8	26.7	4.7	1.5E+23	61	2	2	0.14	124	26	72
492	36.03	27.02	4.7	1.5E+23	29	2	2	0.14	189	42	-72

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
493	36.7	25.8	4.7	1.5E+23	21	2	2	0.14	65	45	-90
494	36.4	27.3	4.7	1.5E+23	10	2	2	0.14	13	77	172
495	36.07	27.46	4.7	1.4E+23	51	2	2	0.14	9	53	-114
496	35.38	27.28	4.7	1.4E+23	58	2	2	0.14	133	52	-168
497	34.89	24.79	4.7	1.4E+23	57	2	2	0.14	169	55	-30
498	36.1	26.8	4.7	1.4E+23	25	2	2	0.14	275	85	-174
499	34.1	35.5	4.7	1.4E+23	74	2	2	0.14	200	70	-27
500	35.4	27.9	4.7	1.4E+23	35	2	2	0.14	314	25	119
501	36.16	27.26	4.7	1.4E+23	20	2	2	0.14	140	30	90
502	35	24.22	4.7	1.4E+23	83	2	2	0.14	314	73	-174
503	36	27.447	4.7	1.4E+23	41	2	2	0.14	199	50	-52
504	36.6	27	4.7	1.4E+23	38	2	2	0.14	140	82	30
505	35.1	27.2	4.7	1.3E+23	32	2	2	0.14	149	81	8
506	35.5	26.4	4.7	1.3E+23	39	2	2	0.13	61	35	-40
507	35.5	27	4.7	1.3E+23	18	2	2	0.13	190	62	-90
508	34.9	27.4	4.7	1.3E+23	24	2	2	0.13	294	31	26
509	35.5	26.4	4.7	1.3E+23	137	2	2	0.13	61	35	-40
510	34.86	26.07	4.7	1.3E+23	8	2	2	0.13	5	35	120
511	34.74	34.41	4.7	1.3E+23	25	2	2	0.13	343	27	133
512	34.42	26.57	4.7	1.2E+23	34	2	2	0.13	107	76	169
513	36.73	28.24	4.7	1.2E+23	7	2	2	0.13	275	52	-34
514	34.4	28.9	4.7	1.2E+23	6	2	2	0.13	60	35	80
515	36.99	26.8	4.7	1.2E+23	30	2	2	0.13	109	41	-70
516	36.6	28.3	4.7	1.2E+23	8	2	2	0.13	89	62	90
517	36.69	26.21	4.7	1.2E+23	23	2	2	0.13	157	49	-31
518	34.16	26.16	4.7	1.1E+23	33	2	2	0.13	104	77	173
519	35.6	27	4.7	1.1E+23	21	2	2	0.13	146	46	110
520	35.27	27.12	4.7	1.1E+23	74	2	2	0.13	234	41	-23
521	36.16	27.26	4.7	1.1E+23	4	2	2	0.13	140	30	90
522	37.83	27	4.7	1.1E+23	62	2	2	0.13	262	41	-127
523	35.12	27.81	4.7	1.1E+23	30	2	2	0.13	1	39	-146
524	36.32	28.27	4.7	1.1E+23	22	2	2	0.13	315	41	-93
525	34.4	28.9	4.7	1.1E+23	15	2	2	0.13	60	35	80

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
526	36.62	24.55	4.7	1.1E+23	11	2	2	0.13	105	36	-81
527	36.6	26.9	4.7	1.1E+23	19	2	2	0.13	315	50	164
528	37.27	26.88	4.6	1.1E+23	107	2	2	0.13	99	49	-77
529	35.91	30.61	4.6	1.1E+23	8	2	2	0.13	185	60	10
530	36.83	27.82	4.6	1.0E+23	15	1	2	0.13	63	27	-115
531	35.1	26.6	4.6	1.0E+23	63	1	2	0.13	172	38	-106
532	34.91	24.719	4.6	1.0E+23	56	1	2	0.13	321	89	-3
533	34.5	25.6	4.6	1.0E+23	12	1	2	0.13	133	21	115
534	36.15	27.22	4.6	1.0E+23	6	1	2	0.13	222	36	-78
535	35.25	35.43	4.6	1.0E+23	42	1	2	0.13	219	43	-10
536	35.02	25.94	4.6	1.0E+23	5	1	2	0.13	205	70	40
537	34.16	26.16	4.6	1.0E+23	26	1	2	0.13	104	77	173
538	34.31	32.33	4.6	9.9E+22	51	1	2	0.12	118	87	-12
539	36.37	28.04	4.6	9.8E+22	44	1	2	0.12	12	30	176
540	35.7	30.8	4.6	9.8E+22	86	1	2	0.12	5	65	130
541	34.44	26.51	4.6	9.8E+22	28	1	2	0.12	309	74	-177
542	35.04	27.23	4.6	9.8E+22	24	1	2	0.12	56	67	10
543	34.1	35.5	4.6	9.7E+22	7	1	2	0.12	200	70	-27
544	34.96	24.24	4.6	9.7E+22	12	1	2	0.12	216	11	10
545	34.95	26.1	4.6	9.6E+22	83	1	2	0.12	340	55	-30
546	36.5	27.07	4.6	9.5E+22	6	1	2	0.12	334	54	-160
547	35.5	25.76	4.6	9.4E+22	3	1	2	0.12	192	41	-73
548	37.77	26.89	4.6	9.3E+22	33	1	2	0.12	344	54	93
549	35.65	26.18	4.6	9.3E+22	58	1	2	0.12	93	20	-94
550	34.64	25.59	4.6	9.0E+22	24	1	2	0.12	77	10	-118
551	34.44	26.497	4.6	8.7E+22	107	1	2	0.12	184	46	-40
552	36	30	4.6	8.4E+22	21	1	2	0.12	145	50	60
553	34.4	32.29	4.6	8.4E+22	16	1	2	0.12	55	35	177
554	34.59	32.21	4.6	8.2E+22	23	1	2	0.12	56	68	175
555	34.46	26.09	4.6	8.2E+22	29	1	2	0.12	306	33	116
556	36.07	27.34	4.6	8.1E+22	14	1	2	0.12	235	67	24
557	35.04	25.92	4.6	8.0E+22	54	1	2	0.12	50	45	-10
558	34.33	33.25	4.6	7.8E+22	44	1	2	0.12	335	27	133

Random Earthquake No	Latitude	Longitude	M_w	M_0	$Focal\ Depth$ (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
559	35	27.1	4.6	7.7E+22	22	1	2	0.12	188	31	-21
560	33.85	35.73	4.6	7.6E+22	35	1	2	0.12	110	55	-60
561	35.19	27.54	4.6	7.5E+22	12	1	2	0.12	62	75	12
562	35.4	26.417	4.6	7.5E+22	17	1	2	0.12	31	70	101
563	35.51	25.862	4.5	7.5E+22	25	1	2	0.12	246	56	-11
564	34.21	26.16	4.5	7.3E+22	9	1	2	0.12	83	10	37
565	35.62	27.68	4.5	7.3E+22	6	1	2	0.12	43	59	-21
566	34.85	25.06	4.5	7.2E+22	42	1	2	0.12	256	65	-11
567	34.7	25.25	4.5	7.2E+22	163	1	2	0.12	127	86	-11
568	34.6	25.5	4.5	7.1E+22	36	1	2	0.11	230	68	-148
569	35.92	27.18	4.5	6.9E+22	25	1	2	0.11	347	35	-111
570	34.47	26.58	4.5	6.8E+22	9	1	2	0.11	185	40	-27
571	34.92	25.179	4.5	6.8E+22	1	1	2	0.11	173	47	-144
572	36.73	28.24	4.5	6.7E+22	37	1	2	0.11	275	52	-34
573	35.07	24.317	4.5	6.7E+22	35	1	2	0.11	311	66	47
574	34.51	26.59	4.5	6.7E+22	40	1	2	0.11	135	76	13
575	36.53	35.33	4.5	6.7E+22	3	1	2	0.11	50	85	10
576	34.92	24.89	4.5	6.6E+22	14	1	2	0.11	55	78	-21
577	35.44	24.81	4.5	6.2E+22	39	1	2	0.11	155	68	-21
578	34.82	24.28	4.5	6.1E+22	20	1	2	0.11	235	39	-8
579	35.16	27.15	4.5	6.1E+22	86	1	2	0.11	234	77	4
580	35.04	32.27	4.5	6.0E+22	22	1	2	0.11	239	21	140
581	36.4	27.3	4.5	6.0E+22	78	1	2	0.11	8	22	-154
582	36.02	28.39	4.5	5.9E+22	60	1	2	0.11	10	34	-116
583	35.73	24.68	4.5	5.9E+22	15	1	2	0.11	240	80	25
584	35.4	27.9	4.5	5.9E+22	11	1	2	0.11	314	25	119
585	36.77	28.13	4.5	5.8E+22	18	1	2	0.11	316	54	137
586	34.45	25.64	4.5	5.7E+22	30	1	2	0.11	78	77	6
587	36.53	35.33	4.5	5.7E+22	61	1	2	0.11	50	85	10
588	36.98	26.81	4.5	5.6E+22	8	1	2	0.11	10	44	-82
589	36.6	26.9	4.5	5.6E+22	38	1	2	0.11	57	46	-72
590	35.86	25.96	4.5	5.6E+22	17	1	2	0.11	225	73	-160
591	36.65	24.53	4.5	5.5E+22	25	1	2	0.11	113	45	-90

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
592	36.5	28.6	4.5	5.5E+22	16	1	2	0.11	58	85	19
593	36.17	31.81	4.5	5.5E+22	16	1	2	0.11	65	20	-90
594	34.9	26.9	4.5	5.4E+22	41	1	1	0.11	227	44	7
595	36.62	27.09	4.5	5.4E+22	57	1	1	0.11	315	44	173
596	34.92	26.75	4.5	5.3E+22	44	1	1	0.11	129	27	-106
597	34.1	32.4	4.4	5.3E+22	47	1	1	0.11	95	75	-30
598	34.8	24.7	4.4	5.3E+22	50	1	1	0.11	264	61	44
599	36.2	27.1	4.4	5.3E+22	43	1	1	0.11	104	72	-167
600	34.9	26.9	4.4	5.2E+22	9	1	1	0.11	227	44	7
601	34.82	26.28	4.4	5.2E+22	6	1	1	0.11	245	36	-33
602	34.8	27.4	4.4	5.2E+22	60	1	1	0.11	34	67	157
603	36.69	25.74	4.4	5.2E+22	39	1	1	0.11	280	70	-47
604	35.04	26.12	4.4	5.1E+22	64	1	1	0.11	240	85	-60
605	34.49	32.12	4.4	5.0E+22	33	1	1	0.10	48	77	170
606	37.8	24.2	4.4	5.0E+22	62	1	1	0.10	224	41	168
607	34.83	24.59	4.4	4.9E+22	61	1	1	0.10	360	49	155
608	35.44	24.81	4.4	4.9E+22	26	1	1	0.10	155	68	-21
609	35.1	26.6	4.4	4.9E+22	51	1	1	0.10	214	52	-47
610	36.11	27.38	4.4	4.8E+22	40	1	1	0.10	94	54	86
611	35.81	29.75	4.4	4.8E+22	64	1	1	0.10	207	39	-34
612	37.26	26.89	4.4	4.8E+22	25	1	1	0.10	70	40	-90
613	37.95	26.74	4.4	4.8E+22	117	1	1	0.10	42	75	172
614	35.6	27	4.4	4.8E+22	10	1	1	0.10	146	46	110
615	34.31	32.33	4.4	4.8E+22	26	1	1	0.10	97	76	-11
616	34.9	32.26	4.4	4.8E+22	19	1	1	0.10	340	55	130
617	35.5	26.4	4.4	4.8E+22	55	1	1	0.10	61	35	-40
618	36.99	26.81	4.4	4.7E+22	14	1	1	0.10	88	51	-69
619	35.28	27.79	4.4	4.7E+22	19	1	1	0.10	325	42	-140
620	34.35	26.16	4.4	4.6E+22	70	1	1	0.10	119	45	114
621	35.74	27.83	4.4	4.6E+22	15	1	1	0.10	349	45	-76
622	35.4	27.9	4.4	4.2E+22	29	1	1	0.10	314	25	119
623	35.4	27.62	4.4	4.1E+22	4	1	1	0.10	212	45	-29
624	34.37	26.35	4.4	4.1E+22	6	1	1	0.10	284	53	38

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
625	34.53	24.44	4.4	4.1E+22	48	1	1	0.10	172	4	-20
626	34.69	32.964	4.4	3.9E+22	79	1	1	0.10	240	31	47
627	36.16	28.14	4.4	3.9E+22	51	1	1	0.10	130	49	97
628	35.4	27.62	4.4	3.9E+22	66	1	1	0.10	212	45	-29
629	34.98	26.25	4.4	3.9E+22	49	1	1	0.10	268	78	-1
630	34.81	27.2	4.4	3.8E+22	17	1	1	0.10	40	70	2
631	34.9	24.65	4.4	3.8E+22	6	1	1	0.10	265	85	75
632	35.24	26.01	4.4	3.8E+22	35	1	1	0.10	15	55	80
633	36.3	26.7	4.4	3.8E+22	27	1	1	0.10	279	89	179
634	34.8	33.67	4.3	3.7E+22	17	1	1	0.10	241	60	132
635	34.7	25.25	4.3	3.7E+22	49	1	1	0.10	127	86	-11
636	36.54	27.88	4.3	3.6E+22	8	1	1	0.10	345	62	172
637	31.96	35.574	4.3	3.6E+22	44	1	1	0.10	90	74	168
638	34.21	26.16	4.3	3.6E+22	99	1	1	0.10	83	10	37
639	36.54	27.88	4.3	3.6E+22	15	1	1	0.10	345	62	172
640	35.59	26.99	4.3	3.5E+22	35	1	1	0.10	310	44	98
641	35.04	24.57	4.3	3.5E+22	13	1	1	0.10	143	14	-45
642	36.72	27.505	4.3	3.5E+22	9	1	1	0.10	193	65	162
643	33.11	34.74	4.3	3.4E+22	37	1	1	0.10	141	85	-60
644	34.51	26.59	4.3	3.4E+22	12	1	1	0.09	135	76	13
645	34.53	24.94	4.3	3.4E+22	44	1	1	0.09	176	78	-171
646	36.15	27.1	4.3	3.3E+22	10	1	1	0.09	196	38	-102
647	35.78	29.7	4.3	3.3E+22	23	1	1	0.09	207	75	8
648	36.08	26.475	4.3	3.3E+22	32	1	1	0.09	328	64	-169
649	35.65	29.8	4.3	3.3E+22	5	1	1	0.09	104	8	-72
650	35.04	26.1	4.3	3.2E+22	65	1	1	0.09	50	45	30
651	34.76	25.46	4.3	3.2E+22	17	1	1	0.09	185	15	-60
652	34.73	25.82	4.3	3.2E+22	46	1	1	0.09	24	58	-42
653	35.82	24.97	4.3	3.1E+22	53	1	1	0.09	140	49	-90
654	34.36	26.03	4.3	3.1E+22	25	1	1	0.09	289	38	110
655	35.51	25.862	4.3	3.1E+22	14	1	1	0.09	246	56	-11
656	34.33	33.25	4.3	3.1E+22	18	1	1	0.09	335	27	133
657	34.81	25.39	4.3	3.0E+22	21	1	1	0.09	140	50	-119

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
658	36.3	27.5	4.3	3.0E+22	9	1	1	0.09	118	84	38
659	36.89	27.85	4.3	3.0E+22	26	1	1	0.09	71	31	-99
660	34.49	32.12	4.3	3.0E+22	65	1	1	0.09	125	12	-73
661	34.5	25.1	4.3	3.0E+22	19	1	1	0.09	286	75	-107
662	34.49	32.071	4.3	3.0E+22	35	1	1	0.09	44	86	-173
663	35.29	35.32	4.3	3.0E+22	55	1	1	0.09	215	58	42
664	36.3	27.5	4.3	2.9E+22	25	1	1	0.09	118	84	38
665	35.31	27.38	4.3	2.9E+22	16	1	1	0.09	150	80	0
666	36.3	27.5	4.3	2.9E+22	12	1	1	0.09	246	21	-11
667	35.48	26.32	4.3	2.9E+22	30	1	1	0.09	61	35	-40
668	34.06	24.68	4.3	2.9E+22	17	1	1	0.09	67	53	29
669	36.63	26.92	4.3	2.9E+22	41	1	1	0.09	92	71	8
670	34.49	32.72	4.3	2.8E+22	20	1	1	0.09	125	50	131
671	34.7	25.25	4.3	2.8E+22	20	1	1	0.09	127	86	-11
672	34.47	26.58	4.3	2.8E+22	41	1	1	0.09	185	40	-27
673	36.1	29.2	4.3	2.8E+22	13	1	1	0.09	100	74	82
674	35.97	30.58	4.3	2.7E+22	9	1	1	0.09	21	45	-147
675	31.8	33.5	4.3	2.7E+22	25	1	1	0.09	44	42	114
676	36.59	25.56	4.3	2.7E+22	44	1	1	0.09	99	49	-128
677	35.7	30.8	4.3	2.7E+22	37	1	1	0.09	30	70	170
678	35.01	24.68	4.3	2.7E+22	54	1	1	0.09	279	55	-35
679	35.55	35.25	4.3	2.7E+22	23	1	1	0.09	163	77	-105
680	34.83	24.59	4.2	2.7E+22	22	1	1	0.09	360	49	155
681	36.59	25.56	4.2	2.6E+22	34	1	1	0.09	99	49	-128
682	34.76	25.81	4.2	2.6E+22	31	1	1	0.09	35	50	150
683	36.72	27.505	4.2	2.5E+22	34	1	1	0.09	193	65	162
684	36.84	27.85	4.2	2.5E+22	51	1	1	0.09	83	23	-83
685	33.11	34.74	4.2	2.5E+22	7	1	1	0.09	141	85	-60
686	34.9	27.4	4.2	2.5E+22	94	1	1	0.09	56	67	-168
687	34.77	25.82	4.2	2.5E+22	56	1	1	0.09	54	58	-42
688	33.11	34.74	4.2	2.5E+22	4	1	1	0.09	141	85	-60
689	35.59	26.99	4.2	2.4E+22	40	1	1	0.09	310	44	98
690	35.07	26.04	4.2	2.4E+22	34	1	1	0.09	70	85	0

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
691	34.3	32.5	4.2	2.3E+22	9	1	1	0.09	270	70	-160
692	34.4	24.95	4.2	2.3E+22	29	1	1	0.09	163	50	44
693	35.2	32.8	4.2	2.3E+22	25	1	1	0.09	80	45	120
694	34.71	24.28	4.2	2.3E+22	13	1	1	0.09	357	48	-128
695	34.83	24.25	4.2	2.3E+22	7	1	1	0.09	289	22	76
696	36.4	27.3	4.2	2.3E+22	28	1	1	0.09	13	77	172
697	35.1	24.6	4.2	2.3E+22	37	1	1	0.09	240	65	34
698	34.1	32.4	4.2	2.3E+22	11	1	1	0.09	95	75	-30
699	36.05	27.76	4.2	2.2E+22	42	1	1	0.09	103	46	24
700	35.72	31.57	4.2	2.2E+22	45	1	1	0.09	43	10	172
701	36.23	28.45	4.2	2.2E+22	56	1	1	0.08	11	26	-57
702	34.49	32.12	4.2	2.2E+22	17	1	1	0.08	48	77	170
703	34.76	25.81	4.2	2.2E+22	65	1	1	0.08	35	50	150
704	36.65	26.27	4.2	2.2E+22	15	1	1	0.08	71	25	-83
705	34.91	25.46	4.2	2.2E+22	50	1	1	0.08	100	40	5
706	34.88	25.43	4.2	2.2E+22	21	1	1	0.08	127	18	-56
707	35.73	24.68	4.2	2.1E+22	20	1	1	0.08	240	80	25
708	36.18	31.51	4.2	2.1E+22	17	1	1	0.08	67	23	-149
709	35.5	26.4	4.2	2.1E+22	132	1	1	0.08	61	35	-40
710	34.81	27.28	4.2	2.1E+22	14	1	1	0.08	255	74	-17
711	34.75	25.74	4.2	2.1E+22	10	1	1	0.08	18	76	117
712	34.42	26.38	4.2	2.1E+22	2	1	1	0.08	132	46	110
713	35.04	26.1	4.2	2.0E+22	16	1	1	0.08	50	45	30
714	35.92	27.18	4.2	2.0E+22	27	1	1	0.08	347	35	-111
715	35.55	28.16	4.2	2.0E+22	83	1	1	0.08	348	67	-179
716	34.95	25.56	4.2	2.0E+22	7	1	1	0.08	160	75	80
717	35.5	26	4.2	2.0E+22	31	1	1	0.08	272	12	132
718	35	24.22	4.2	2.0E+22	24	1	1	0.08	314	73	-174
719	34.95	25.26	4.2	2.0E+22	9	1	1	0.08	160	75	80
720	34.49	32.071	4.2	2.0E+22	36	1	1	0.08	44	86	-173
721	33.74	35.46	4.2	1.9E+22	42	1	1	0.08	87	43	-178
722	36.9	27.9	4.2	1.9E+22	3	1	1	0.08	83	36	-103
723	34.5	25.26	4.2	1.9E+22	9	1	1	0.08	225	14	40

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
724	34.85	25.36	4.2	1.9E+22	34	1	1	0.08	248	61	1
725	34.77	26.37	4.1	1.9E+22	29	1	1	0.08	252	22	1
726	36.15	27.22	4.1	1.8E+22	35	1	1	0.08	222	36	-78
727	35.04	27.43	4.1	1.8E+22	34	1	1	0.08	323	73	162
728	35.1	26.6	4.1	1.8E+22	81	1	1	0.08	172	38	-106
729	35.8	31	4.1	1.8E+22	13	1	1	0.08	50	75	150
730	34.67	24.88	4.1	1.8E+22	18	1	1	0.08	180	40	60
731	34.48	32.13	4.1	1.8E+22	51	1	1	0.08	14	53	165
732	34.53	24.94	4.1	1.7E+22	4	1	1	0.08	176	78	-171
733	36	27.447	4.1	1.7E+22	13	1	1	0.08	199	50	-52
734	34.67	24.88	4.1	1.7E+22	31	1	1	0.08	180	40	60
735	35.04	25.08	4.1	1.7E+22	22	1	1	0.08	290	90	180
736	34.56	32.13	4.1	1.7E+22	34	1	1	0.08	48	77	170
737	37.27	26.88	4.1	1.7E+22	1	1	1	0.08	99	49	-77
738	36.14	31.16	4.1	1.7E+22	26	1	1	0.08	70	79	-4
739	34.89	24.86	4.1	1.6E+22	25	1	1	0.08	190	75	-139
740	35.6	27	4.1	1.6E+22	51	1	1	0.08	146	46	110
741	35.04	32.31	4.1	1.6E+22	68	1	1	0.08	71	34	-9
742	35.78	29.7	4.1	1.5E+22	52	1	1	0.08	207	75	8
743	34.9	27.4	4.1	1.5E+22	27	1	1	0.08	294	31	26
744	33.75	28.5	4.1	1.5E+22	8	1	1	0.08	220	45	90
745	34.53	33.6	4.1	1.5E+22	7	1	1	0.08	280	70	-160
746	35.3	31.2	4.1	1.5E+22	19	1	1	0.08	160	30	111
747	35	33.9	4.1	1.5E+22	6	1	1	0.08	95	45	110
748	37	26.8	4.1	1.4E+22	5	1	1	0.08	305	60	-138
749	36.1	26.8	4.1	1.4E+22	61	1	1	0.08	275	85	-174
750	35.1	30.54	4.1	1.4E+22	35	1	1	0.08	265	68	-171
751	34.63	28.36	4.1	1.4E+22	22	1	1	0.08	99	37	-53
752	36.25	28.28	4.1	1.4E+22	30	1	1	0.08	38	55	170
753	35.5	26.4	4.1	1.4E+22	14	1	1	0.08	61	35	-40
754	34.35	26.16	4.1	1.4E+22	50	1	1	0.08	119	45	114
755	34.39	28.3	4.1	1.4E+22	2	1	1	0.08	67	48	-34
756	35.4	25.9	4.1	1.4E+22	13	1	1	0.08	7	16	114

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
757	34.46	26.09	4.0	1.3E+22	39	1	1	0.07	306	33	116
758	35.58	24.72	4.0	1.3E+22	61	1	1	0.07	177	63	22
759	35.62	27.68	4.0	1.3E+22	34	1	1	0.07	43	59	-21
760	32.2	29.6	4.0	1.3E+22	37	1	1	0.07	315	59	36
761	36.79	27.826	4.0	1.3E+22	28	1	1	0.07	73	34	-99
762	35.1	26.6	4.0	1.2E+22	60	1	1	0.07	172	38	-106
763	35.97	30.58	4.0	1.2E+22	15	1	1	0.07	21	45	-147
764	34.2	25.8	4.0	1.2E+22	25	1	1	0.07	122	15	119
765	35.4	25.9	4.0	1.2E+22	27	1	1	0.07	7	16	114
766	36.2	27.1	4.0	1.2E+22	42	1	1	0.07	104	72	-167
767	36.16	28.14	4.0	1.2E+22	40	1	1	0.07	130	49	97
768	35.1	27.2	4.0	1.1E+22	18	1	1	0.07	149	81	8
769	35.12	27.81	4.0	1.1E+22	7	1	1	0.07	1	39	-146
770	36.77	28.13	4.0	1.1E+22	17	1	1	0.07	316	54	137
771	34.81	25.81	4.0	1.0E+22	13	1	1	0.07	40	50	140
772	34.63	33.86	4.0	1.0E+22	10	1	1	0.07	70	35	50
773	35.34	27.47	4.0	9.9E+21	13	1	1	0.07	309	32	98
774	34.19	26.15	4.0	9.7E+21	74	1	1	0.07	292	40	96
775	33.65	25.501	4.0	9.6E+21	12	1	1	0.07	345	85	-179
776	36.1	27.4	4.0	9.4E+21	8	1	1	0.07	350	30	142
777	36.23	28.45	3.9	9.3E+21	44	1	1	0.07	11	26	-57
778	35.08	26.52	3.9	9.0E+21	1	1	1	0.07	105	72	-177
779	34.64	25.5	3.9	9.0E+21	72	1	1	0.07	3	38	150
780	34.79	32.94	3.9	8.8E+21	49	0	1	0.07	302	42	124
781	34.98	26.25	3.9	8.7E+21	80	0	1	0.07	268	78	-1
782	36.14	31.16	3.9	8.7E+21	51	0	1	0.07	70	79	-4
783	34.73	25.82	3.9	8.4E+21	27	0	1	0.07	24	58	-42
784	34.86	26.07	3.9	8.2E+21	65	0	1	0.07	5	35	120
785	35.75	25	3.9	8.2E+21	19	0	1	0.07	270	69	112
786	34.5	25.1	3.9	8.1E+21	10	0	1	0.07	286	75	-107
787	34.4	32.11	3.9	8.1E+21	36	0	1	0.07	324	73	-17
788	34.44	26.51	3.9	8.0E+21	36	0	1	0.07	309	74	-177
789	37	26.8	3.9	7.7E+21	11	0	1	0.06	305	60	-138

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
790	34.91	24.8	3.9	7.6E+21	45	0	1	0.06	142	22	-35
791	37.95	26.74	3.9	7.4E+21	66	0	1	0.06	42	75	172
792	34.82	26.28	3.9	7.4E+21	6	0	1	0.06	245	36	-33
793	34.71	33.5	3.9	7.3E+21	10	0	1	0.06	145	25	110
794	36.4	28.6	3.9	7.1E+21	15	0	1	0.06	114	29	28
795	34.91	25.43	3.9	7.0E+21	31	0	1	0.06	280	35	48
796	34.95	26.1	3.9	7.0E+21	66	0	1	0.06	340	55	-30
797	31.8	33.5	3.9	6.8E+21	25	0	1	0.06	44	42	114
798	35.69	25.71	3.9	6.8E+21	12	0	1	0.06	157	49	-108
799	34.94	26.1	3.8	6.6E+21	111	0	1	0.06	90	65	-170
800	36.11	27.21	3.8	6.5E+21	13	0	1	0.06	0	40	-114
801	34.93	25.04	3.8	6.5E+21	27	0	1	0.06	359	26	76
802	34.71	24.28	3.8	6.5E+21	24	0	1	0.06	357	48	-128
803	34.94	26.1	3.8	6.4E+21	31	0	1	0.06	90	65	-170
804	35.8	29.7	3.8	6.4E+21	25	0	1	0.06	216	40	-13
805	35.16	27.15	3.8	6.4E+21	48	0	1	0.06	234	77	4
806	35.05	26.11	3.8	6.3E+21	21	0	1	0.06	70	71	16
807	35.2	32.8	3.8	6.2E+21	8	0	1	0.06	80	45	120
808	34.95	26.1	3.8	6.1E+21	40	0	1	0.06	340	55	-30
809	36.27	27.17	3.8	6.0E+21	29	0	1	0.06	211	40	-31
810	36.35	29.39	3.8	6.0E+21	7	0	1	0.06	94	75	104
811	34.51	26.59	3.8	5.8E+21	64	0	1	0.06	227	37	23
812	34.19	25.8	3.8	5.7E+21	37	0	1	0.06	262	40	102
813	34.64	25.59	3.8	5.6E+21	7	0	1	0.06	77	10	-118
814	37.95	26.74	3.8	5.5E+21	17	0	1	0.06	42	75	172
815	36.63	24.27	3.8	5.3E+21	43	0	1	0.06	258	80	177
816	36.6	26.9	3.8	5.3E+21	14	0	1	0.06	315	50	164
817	36.4	28.6	3.8	5.3E+21	6	0	1	0.06	233	14	126
818	34.19	25.8	3.8	5.3E+21	7	0	1	0.06	262	40	102
819	35.16	27.26	3.8	5.2E+21	16	0	1	0.06	147	44	-117
820	34.91	24.8	3.8	5.1E+21	24	0	1	0.06	142	22	-35
821	34.82	24.28	3.8	5.0E+21	41	0	1	0.06	235	39	-8
822	36.54	27.88	3.8	5.0E+21	30	0	1	0.06	345	62	172

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
823	34.75	33.04	3.8	4.9E+21	7	0	1	0.06	92	64	67
824	34.92	24.89	3.8	4.9E+21	45	0	1	0.06	55	78	-21
825	36.2	28.9	3.8	4.9E+21	60	0	1	0.06	193	24	3
826	34.9	26.3	3.8	4.8E+21	87	0	1	0.06	144	70	86
827	36.6	26.9	3.8	4.8E+21	84	0	1	0.06	57	46	-72
828	35.29	35.32	3.8	4.8E+21	5	0	1	0.06	215	58	42
829	37.31	24.67	3.7	4.5E+21	53	0	1	0.06	256	50	16
830	34.81	25.81	3.7	4.5E+21	7	0	1	0.06	40	50	140
831	36.6	28.3	3.7	4.5E+21	14	0	1	0.06	89	62	90
832	31.96	35.574	3.7	4.4E+21	10	0	1	0.06	90	74	168
833	35.07	26.71	3.7	4.4E+21	14	0	1	0.06	172	38	-106
834	35.7	30.6	3.7	4.3E+21	6	0	1	0.06	302	69	165
835	35.04	25.08	3.7	4.3E+21	37	0	1	0.06	290	90	180
836	36.2	27.1	3.7	4.2E+21	9	0	1	0.06	104	72	-167
837	35.04	32.27	3.7	4.2E+21	9	0	1	0.06	239	21	140
838	35.58	24.72	3.7	4.2E+21	25	0	1	0.06	177	63	22
839	36.18	31.51	3.7	4.2E+21	4	0	1	0.06	67	23	-149
840	33.88	24.16	3.7	4.1E+21	39	0	1	0.06	179	72	-14
841	36.27	27.17	3.7	4.1E+21	25	0	1	0.06	211	40	-31
842	35.6	24.5	3.7	4.0E+21	31	0	1	0.06	191	65	-79
843	34.81	25.39	3.7	4.0E+21	26	0	1	0.05	140	50	-119
844	35.95	27.42	3.7	3.9E+21	20	0	1	0.05	53	19	-129
845	34.4	24.5	3.7	3.9E+21	15	0	1	0.05	127	25	51
846	36.15	27.2	3.7	3.7E+21	32	0	1	0.05	130	40	-148
847	35.62	27.68	3.7	3.6E+21	45	0	1	0.05	43	59	-21
848	36.1	27.23	3.7	3.6E+21	25	0	1	0.05	295	10	93
849	35.1	26.6	3.7	3.5E+21	23	0	1	0.05	172	38	-106
850	36.88	27.7	3.7	3.5E+21	37	0	1	0.05	60	37	-112
851	32.9	29.8	3.7	3.5E+21	52	0	1	0.05	215	72	22
852	35.5	26.4	3.7	3.4E+21	97	0	1	0.05	61	35	-40
853	34.91	24.719	3.7	3.4E+21	13	0	1	0.05	321	89	-3
854	37.63	26.72	3.6	3.2E+21	26	0	1	0.05	10	49	108
855	34.8	27.4	3.6	3.0E+21	16	0	1	0.05	34	67	157

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
856	35.05	26.11	3.6	3.0E+21	20	0	1	0.05	70	71	16
857	34.58	24.77	3.6	3.0E+21	57	0	1	0.05	47	34	-115
858	35.38	27.28	3.6	2.9E+21	16	0	1	0.05	133	52	-168
859	35	27.1	3.6	2.9E+21	6	0	1	0.05	188	31	-21
860	36.3	27.5	3.6	2.8E+21	21	0	1	0.05	246	21	-11
861	34.9	27.4	3.6	2.8E+21	14	0	1	0.05	54	70	176
862	35.04	27.46	3.6	2.8E+21	29	0	1	0.05	51	48	-29
863	37.83	27	3.6	2.8E+21	51	0	1	0.05	262	41	-127
864	34.6	26.3	3.6	2.8E+21	2	0	1	0.05	143	69	85
865	34.63	28.36	3.6	2.7E+21	68	0	1	0.05	99	37	-53
866	34.4	25.2	3.6	2.6E+21	6	0	1	0.05	120	63	90
867	36.98	26.81	3.6	2.6E+21	12	0	1	0.05	10	44	-82
868	36.5	27.07	3.6	2.5E+21	109	0	1	0.05	334	54	-160
869	34.76	25.81	3.6	2.4E+21	100	0	1	0.05	35	50	150
870	34.9	32.2	3.6	2.4E+21	14	0	1	0.05	145	67	13
871	36.56	30.71	3.6	2.4E+21	46	0	1	0.05	178	30	4
872	35.14	27.71	3.5	2.3E+21	5	0	1	0.05	315	82	174
873	35.04	27.23	3.5	2.3E+21	11	0	1	0.05	56	67	10
874	35.65	26.18	3.5	2.3E+21	12	0	1	0.05	93	20	-94
875	34.92	24.27	3.5	2.3E+21	56	0	1	0.05	63	76	157
876	35.7	25	3.5	2.2E+21	41	0	1	0.05	238	29	33
877	35.76	28.64	3.5	2.2E+21	29	0	1	0.05	342	73	177
878	35.2	35.6	3.5	2.2E+21	15	0	1	0.05	259	69	0
879	36.1	27.4	3.5	2.1E+21	20	0	1	0.05	350	30	142
880	34.01	25.88	3.5	2.1E+21	22	0	1	0.05	138	80	178
881	34.36	26.03	3.5	2.0E+21	27	0	1	0.05	289	38	110
882	36.8	26.4	3.5	2.0E+21	14	0	1	0.05	231	84	-180
883	35.4	26.18	3.5	2.0E+21	32	0	1	0.05	0	20	40
884	35.04	27.46	3.5	2.0E+21	33	0	1	0.05	51	48	-29
885	35.24	27.12	3.5	1.9E+21	38	0	1	0.05	5	10	8
886	34.3	26.17	3.5	1.9E+21	26	0	1	0.05	8	40	-159
887	35.96	30.65	3.5	1.9E+21	17	0	1	0.05	145	15	-60
888	36.7	26.3	3.5	1.9E+21	60	0	1	0.05	74	54	46

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
889	34.31	32.33	3.5	1.8E+21	8	0	1	0.05	118	87	-12
890	35.1	30.54	3.5	1.8E+21	18	0	1	0.04	265	68	-171
891	35.77	25.39	3.5	1.8E+21	50	0	1	0.04	160	60	-138
892	34.94	26.12	3.5	1.8E+21	47	0	1	0.04	36	33	-28
893	35.2	27.12	3.5	1.7E+21	25	0	1	0.04	244	57	-5
894	34.95	24.91	3.4	1.7E+21	46	0	1	0.04	309	56	-72
895	34.19	26.15	3.4	1.7E+21	64	0	1	0.04	292	40	96
896	35.2	32.8	3.4	1.7E+21	11	0	1	0.04	80	45	120
897	36.07	27.46	3.4	1.6E+21	10	0	1	0.04	9	53	-114
898	31.8	33.5	3.4	1.6E+21	18	0	1	0.04	44	42	114
899	35.07	26.71	3.4	1.6E+21	37	0	1	0.04	172	38	-106
900	36.16	27.26	3.4	1.6E+21	14	0	1	0.04	140	30	90
901	36.1	27.4	3.4	1.6E+21	128	0	1	0.04	350	30	142
902	34	25.5	3.4	1.5E+21	21	0	1	0.04	296	37	111
903	34.86	24.68	3.4	1.5E+21	78	0	1	0.04	223	80	24
904	34.95	25.56	3.4	1.5E+21	60	0	1	0.04	160	75	80
905	35.72	31.57	3.4	1.5E+21	20	0	1	0.04	43	10	172
906	34.84	25.8	3.4	1.4E+21	10	0	1	0.04	180	41	-96
907	35.04	26.12	3.4	1.4E+21	24	0	1	0.04	240	85	-60
908	34.89	24.86	3.4	1.4E+21	30	0	1	0.04	190	75	-139
909	36.3	27.5	3.4	1.4E+21	43	0	1	0.04	246	21	-11
910	36.69	26.21	3.4	1.3E+21	25	0	0	0.04	157	49	-31
911	35.79	28.49	3.4	1.3E+21	40	0	0	0.04	78	61	-24
912	36.7	27.4	3.4	1.2E+21	6	0	0	0.04	60	45	-90
913	34.93	25.04	3.4	1.2E+21	34	0	0	0.04	359	26	76
914	36.69	26.96	3.4	1.2E+21	37	0	0	0.04	312	46	162
915	36.5	27.07	3.4	1.2E+21	105	0	0	0.04	334	54	-160
916	35	27.48	3.3	1.2E+21	1	0	0	0.04	214	60	-34
917	35.72	31.57	3.3	1.2E+21	5	0	0	0.04	43	10	172
918	36.03	27.02	3.3	1.1E+21	36	0	0	0.04	189	42	-72
919	34.9	24.65	3.3	1.1E+21	9	0	0	0.04	265	85	75
920	34.92	24.89	3.3	1.1E+21	33	0	0	0.04	55	78	-21
921	34.83	24.25	3.3	1.0E+21	13	0	0	0.04	289	22	76

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	*L* (km)	*W* (km)	*D* (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
922	35.28	27.79	3.3	9.9E+20	66	0	0	0.04	325	42	-140
923	35.28	27.79	3.3	9.0E+20	26	0	0	0.04	325	42	-140
924	37.77	26.89	3.3	8.6E+20	34	0	0	0.04	344	54	93
925	35.5	26.4	3.3	8.4E+20	29	0	0	0.04	61	35	-40
926	34.76	25.46	3.2	8.1E+20	17	0	0	0.04	185	15	-60
927	35.44	24.81	3.2	8.1E+20	47	0	0	0.04	155	68	-21
928	34.89	24.79	3.2	8.1E+20	16	0	0	0.04	169	55	-30
929	36.5	28.6	3.2	7.8E+20	8	0	0	0.04	58	85	19
930	33.6	27.5	3.2	7.0E+20	15	0	0	0.04	42	59	-169
931	34.53	24.44	3.2	6.8E+20	42	0	0	0.03	172	4	-20
932	35.75	25	3.2	6.6E+20	24	0	0	0.03	270	69	112
933	34.4	24.95	3.2	6.5E+20	55	0	0	0.03	163	50	44
934	34.43	26.24	3.2	6.2E+20	41	0	0	0.03	234	4	58
935	36.59	25.56	3.2	6.1E+20	49	0	0	0.03	99	49	-128
936	35	33.9	3.1	5.8E+20	17	0	0	0.03	95	45	110
937	35.96	30.65	3.1	5.7E+20	45	0	0	0.03	145	15	-60
938	35.5	27	3.1	5.6E+20	98	0	0	0.03	190	62	-90
939	36.03	32.32	3.1	5.5E+20	16	0	0	0.03	326	75	-173
940	33.7	35.5	3.1	5.4E+20	2	0	0	0.03	160	75	-40
941	34.95	25.26	3.1	5.3E+20	26	0	0	0.03	160	75	80
942	36.41	31.75	3.1	5.3E+20	16	0	0	0.03	48	27	-133
943	35.95	27.42	3.1	5.2E+20	69	0	0	0.03	53	19	-129
944	34.77	25.82	3.1	5.0E+20	24	0	0	0.03	54	58	-42
945	35.5	27	3.1	4.6E+20	88	0	0	0.03	325	70	90
946	35.63	27.49	3.1	4.4E+20	77	0	0	0.03	353	38	-80
947	34.88	25.75	3.0	4.1E+20	99	0	0	0.03	40	49	-90
948	35.38	27.28	3.0	3.9E+20	3	0	0	0.03	133	52	-168
949	36.63	24.27	3.0	3.4E+20	41	0	0	0.03	258	80	177
950	35.19	27.54	3.0	3.4E+20	23	0	0	0.03	62	75	12
951	34.35	26.16	3.0	3.3E+20	87	0	0	0.03	119	45	114
952	36.37	28.04	3.0	3.0E+20	29	0	0	0.03	12	30	176
953	34.9	26.3	3.0	3.0E+20	26	0	0	0.03	144	70	86
954	35.14	27.71	3.0	3.0E+20	14	0	0	0.03	315	82	174

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
955	34.91	25.43	2.9	3.0E+20	28	0	0	0.03	280	35	48
956	36.1	29.2	2.9	3.0E+20	2	0	0	0.03	100	74	82
957	35.4	26.417	2.9	2.9E+20	37	0	0	0.03	31	70	101
958	32.75	24.37	2.9	2.8E+20	64	0	0	0.03	326	40	-7
959	34.88	25.43	2.9	2.7E+20	8	0	0	0.03	127	18	-56
960	36.15	27.51	2.9	2.7E+20	28	0	0	0.03	184	70	-90
961	35.14	27.71	2.9	2.4E+20	17	0	0	0.03	315	82	174
962	34.83	24.25	2.8	2.1E+20	44	0	0	0.03	289	22	76
963	35.07	26.04	2.8	2.0E+20	57	0	0	0.03	70	85	0
964	36.7	35.88	2.8	2.0E+20	21	0	0	0.03	204	28	-93
965	35.06	32.26	2.8	1.8E+20	12	0	0	0.02	224	20	133
966	35.27	27.12	2.8	1.6E+20	25	0	0	0.02	234	41	-23
967	35	26.5	2.8	1.6E+20	19	0	0	0.02	264	41	16
968	37.8	24.2	2.8	1.6E+20	23	0	0	0.02	224	41	168
969	34.74	24.85	2.8	1.5E+20	3	0	0	0.02	125	3	-64
970	35.74	27.83	2.7	1.4E+20	16	0	0	0.02	349	45	-76
971	34.91	25.46	2.7	1.4E+20	52	0	0	0.02	100	40	5
972	35.34	27.47	2.7	1.3E+20	37	0	0	0.02	309	32	98
973	35.07	26.11	2.6	8.6E+19	18	0	0	0.02	85	80	60
974	31.6	30.2	2.6	8.2E+19	19	0	0	0.02	307	7	-110
975	34.47	26.58	2.6	7.7E+19	28	0	0	0.02	185	40	-27
976	34.69	32.964	2.5	7.3E+19	61	0	0	0.02	240	31	47
977	35.04	27.43	2.5	6.8E+19	45	0	0	0.02	323	73	162
978	36.3	27.5	2.5	6.1E+19	46	0	0	0.02	246	21	-11
979	34.7	24.7	2.5	5.7E+19	36	0	0	0.02	320	80	-164
980	34.51	26.59	2.5	5.6E+19	13	0	0	0.02	227	37	23
981	36.11	27.38	2.5	5.4E+19	40	0	0	0.02	94	54	86
982	34.49	32.12	2.4	4.9E+19	26	0	0	0.02	40	64	162
983	35.06	26.41	2.4	4.4E+19	66	0	0	0.02	78	64	-21
984	35.6	24.5	2.4	4.1E+19	60	0	0	0.02	191	65	-79
985	34.76	25.46	2.4	3.8E+19	56	0	0	0.02	185	15	-60
986	34.71	32.89	2.3	3.7E+19	28	0	0	0.02	285	16	71
987	34.45	25.64	2.3	3.7E+19	36	0	0	0.02	78	77	6

Random Earthquake No	Latitude	Longitude	M_w	M_0	*Focal Depth* (km)	L (km)	W (km)	D (m)	Strike (^{0})	Dip (^{0})	Rake (^{0})
988	36.82	27.25	2.3	3.6E+19	28	0	0	0.02	329	75	90
989	35.5	26.4	2.3	3.2E+19	51	0	0	0.02	61	35	-40
990	34.49	32.72	2.3	2.9E+19	61	0	0	0.02	125	50	131
991	36.1	27.4	2.3	2.9E+19	27	0	0	0.02	350	30	142
992	35.55	28.16	2.2	2.6E+19	33	0	0	0.02	348	67	-179
993	34.81	27.2	2.2	2.1E+19	13	0	0	0.01	40	70	2
994	36.69	26.96	2.2	2.0E+19	61	0	0	0.01	312	46	162
995	34.4	24.5	2.2	1.9E+19	72	0	0	0.01	127	25	51
996	36.1	27.23	2.1	1.5E+19	26	0	0	0.01	295	10	93
997	36.36	26.95	2.0	9.5E+18	28	0	0	0.01	339	32	-177
998	34.53	24.44	1.9	7.6E+18	12	0	0	0.01	172	4	-20
999	36.65	24.53	1.8	6.2E+18	16	0	0	0.01	113	45	-90
1000	34.75	24.77	1.5	2.2E+18	19	0	0	0.01	55	35	-70

APPENDIX C - DEPTH-DAMAGE FUNCTIONS AND MAXIMUM DAMAGE VALUES

In risk assessment procedure, calculation of damage values with respect to tsunami wave height at the coast for different damage classes (i.e. residential, industrial, agricultural, and environmental) are conducted using the methodology proposed by Huizinga et. al., (2017). Depth-damage functions provided by Huizinga et al. (2017) at continental level are given in Table C.1. Depth-damage functions for Africa, Asia and Europe are used to calculate damage values of each damage classes in this study. The maximum damage values are required to calculate depth-damage values for each country. The maximum damage values provided in Huizinga et al. (2017) for the countries used in this study are given in Table C.2. for all damage classes.

Table C.1 Depth-damage functions for all damage classes at continental level (Huizinga et al. 2017)

Damage class	Flood depth, [m]	Damage function							Standard deviation						
		EUROPE	North AMERICA	Centr&South AMERICA	ASIA	AFRICA	OCEANIA	GLOBAL	EUROPE	North AMERICA	Centr&South AMERICA	ASIA	AFRICA	OCEANIA	GLOBAL
Residential buildings	0	0.00	0.20	0.00	0.00	0.00	0.00	-	-	0.17	0.00	0.00	0.00	0.09	-
	0.5	0.25	0.44	0.49	0.33	0.22	0.48	-	-	0.14	0.21	0.25	0.04	0.14	-
	1	0.40	0.58	0.71	0.49	0.38	0.64	-	-	0.14	0.14	0.22	0.11	0.16	-
	1.5	0.50	0.68	0.84	0.62	0.53	0.71	-	-	0.17	0.08	0.21	0.20	0.17	-
	2	0.60	0.78	0.95	0.72	0.64	0.79	-	-	0.14	0.06	0.21	0.21	0.17	-
	3	0.75	0.85	0.98	0.87	0.82	0.93	-	-	0.13	0.02	0.17	0.21	0.11	-
	4	0.85	0.92	1.00	0.93	0.90	0.97	-	-	0.10	0.00	0.12	0.14	0.06	-
	5	0.95	0.96	1.00	0.98	0.96	0.98	-	-	0.06	0.00	0.05	0.08	0.04	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	-	-	0.00	0.00	0.00	0.00	0.00	-
Commercial buildings	0	0.00	0.02	0.00	0.00	-	0.00	0.00	-	-	0.00	0.00	-	0.00	-
	0.5	0.25	0.24	0.61	0.38	-	0.24	0.34	-	-	0.08	0.24	-	0.14	-
	1	0.40	0.37	0.84	0.54	-	0.48	0.53	-	-	0.04	0.24	-	0.20	-
	1.5	0.50	0.47	0.92	0.66	-	0.67	0.64	-	-	0.03	0.24	-	0.19	-
	2	0.60	0.55	0.99	0.76	-	0.86	0.75	-	-	0.02	0.25	-	0.18	-
	3	0.75	0.69	1.00	0.88	-	1.00	0.86	-	-	0.00	0.17	-	0.00	-
	4	0.85	0.82	1.00	0.94	-	1.00	0.92	-	-	0.00	0.11	-	0.00	-
	5	0.95	0.91	1.00	0.98	-	1.00	0.97	-	-	0.00	0.05	-	0.00	-
	6	1.00	1.00	1.00	1.00	-	1.00	1.00	-	-	0.00	0.00	-	0.00	-
Industrial buildings	0	0.00	0.03	0.00	0.00	0.00	-	0.00	-	-	0	0.00	-	-	-
	0.5	0.25	0.32	0.67	0.28	0.06	-	0.32	-	-	0.17	0.24	-	-	-
	1	0.40	0.51	0.89	0.48	0.25	-	0.51	-	-	0.10	0.30	-	-	-
	1.5	0.50	0.64	0.95	0.63	0.40	-	0.62	-	-	0.05	0.30	-	-	-
	2	0.60	0.74	1.00	0.72	0.49	-	0.71	-	-	0	0.27	-	-	-
	3	0.75	0.86	1.00	0.86	0.68	-	0.83	-	-	0	0.23	-	-	-
	4	0.85	0.94	1.00	0.91	0.92	-	0.92	-	-	0	0.16	-	-	-
	5	0.95	0.98	1.00	0.96	1.00	-	0.98	-	-	0	0.08	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	-	1.00	-	-	0	0.00	-	-	-
Transport	0	0.00	-	0.00	0.00	-	-	0.00	-	-	-	0.00	-	-	-
	0.5	0.25	-	0.09	0.36	-	-	0.23	-	-	-	0.30	-	-	-
	1	0.40	-	0.18	0.57	-	-	0.38	-	-	-	0.28	-	-	-
	1.5	0.50	-	0.60	0.73	-	-	0.61	-	-	-	0.25	-	-	-
	2	0.60	-	0.84	0.85	-	-	0.76	-	-	-	0.17	-	-	-
	3	0.75	-	1.00	1.00	-	-	0.92	-	-	-	0.00	-	-	-
	4	0.85	-	1.00	1.00	-	-	0.95	-	-	-	0.00	-	-	-
	5	0.95	-	1.00	1.00	-	-	0.98	-	-	-	0.00	-	-	-
	6	1.00	-	1.00	1.00	-	-	1.00	-	-	-	0.00	-	-	-
Infrastructure - roads	0	0.00	-	-	0.00	-	-	0.00	-	-	-	0.00	-	-	-
	0.5	0.25	-	-	0.21	-	-	0.23	-	-	-	0.07	-	-	-
	1	0.40	-	-	0.37	-	-	0.39	-	-	-	0.07	-	-	-
	1.5	0.50	-	-	0.60	-	-	0.55	-	-	-	0.21	-	-	-
	2	0.60	-	-	0.71	-	-	0.65	-	-	-	0.27	-	-	-
	3	0.75	-	-	0.81	-	-	0.78	-	-	-	0.22	-	-	-
	4	0.85	-	-	0.89	-	-	0.87	-	-	-	0.13	-	-	-
	5	0.95	-	-	0.97	-	-	0.96	-	-	-	0.06	-	-	-
	6	1.00	-	-	1.00	-	-	1.00	-	-	-	0.00	-	-	-
Agriculture	0	0.00	0.02	-	0.00	0.00	-	0.00	-	-	-	0.00	0.00	-	-
	0.5	0.25	0.27	-	0.14	0.24	-	0.22	-	-	-	0.19	0.10	-	-
	1	0.40	0.47	-	0.37	0.47	-	0.43	-	-	-	0.35	0.18	-	-
	1.5	0.50	0.55	-	0.52	0.74	-	0.58	-	-	-	0.48	0.25	-	-
	2	0.60	0.60	-	0.56	0.92	-	0.67	-	-	-	0.46	0.14	-	-
	3	0.75	0.76	-	0.66	1.00	-	0.79	-	-	-	0.36	0.00	-	-
	4	0.85	0.87	-	0.83	1.00	-	0.89	-	-	-	0.16	0.00	-	-
	5	0.95	0.95	-	0.99	1.00	-	0.97	-	-	-	0.03	0.00	-	-
	6	1.00	1.00	-	1.00	1.00	-	1.00	-	-	-	0.00	0.00	-	-

Table C.2 Maximum damage values of damage classes for each country in the study area (Huizinga et al. 2017)

Country	Damage Classes		
	Residential ($\frac{€}{m^2}$)	Industrial ($\frac{€}{m^2}$)	Agricultural ($\frac{€}{ha}$)
Cyprus	134	232	2930
Egypt	55	110	6077
Greece	132	229	838
Israel	139	238	6451
Lebanon	86	159	1849
Syria	70	133	681
Turkey	91	167	1161

APPENDIX D - INFORMATION SHEETS FOR EACH ELEMENTS AT RISK

Economic, social and environmental risk dimensions are calculated using exceedance probability and damage values for all 91 EaR. Detailed information about social, economic and environmental damage values, tsunami wave height frequencies obtained from 1000 Monte Carlo experiments, and probabilistic tsunami risk map for the worst case scenario (see Section 3.4.2.4) for each EaR is given in Information sheets D.1 to D.91.

D.1 Information sheet for Akdeniz Summer Villages

Table D.1 Economic and Social Damages Values for Akdeniz Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3342
1.00	247500	11	6684
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

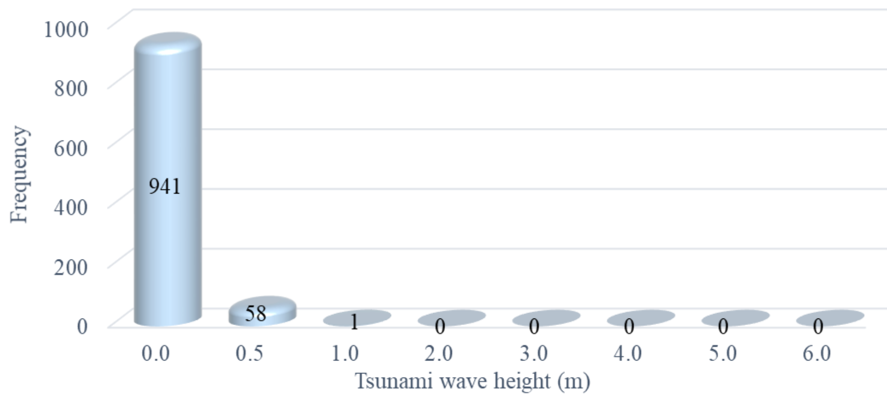

Figure D.1.1 Tsunami wave height frequency plot for Akdeniz Summer Villages

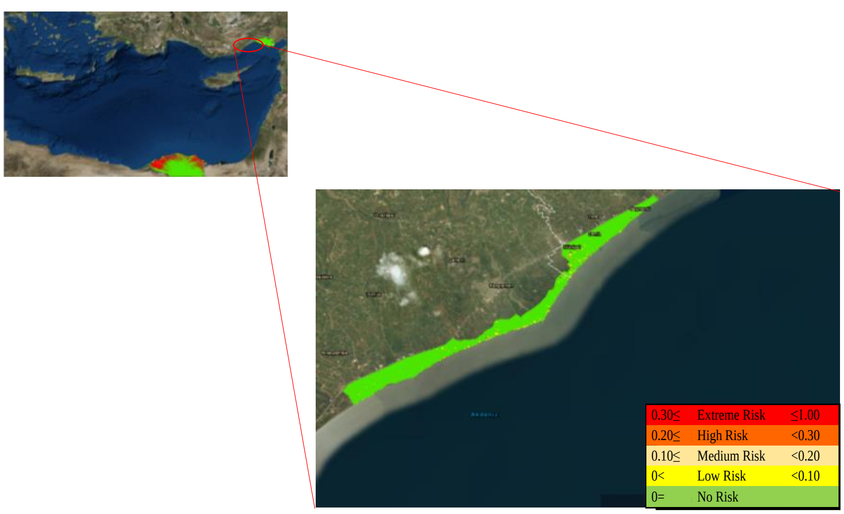

Figure D.1.2 Tsunami risk map for Akdeniz Summer Villages

D.2 Information sheet for Al Arish City Centre

Table D.2 Economic and Social Damages Values for Al Arish City Centre

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1460
1.00	0	0	-
2.00	948600	53	7805
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

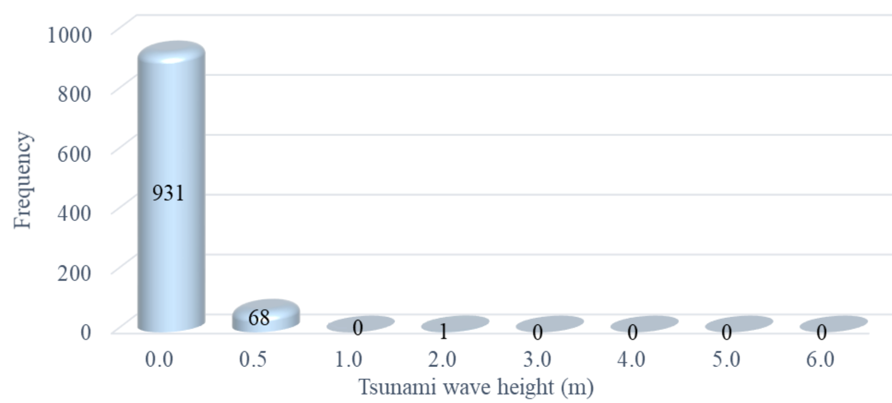

Figure D.2.1 Tsunami wave height frequency plot for Al Arish City Centre

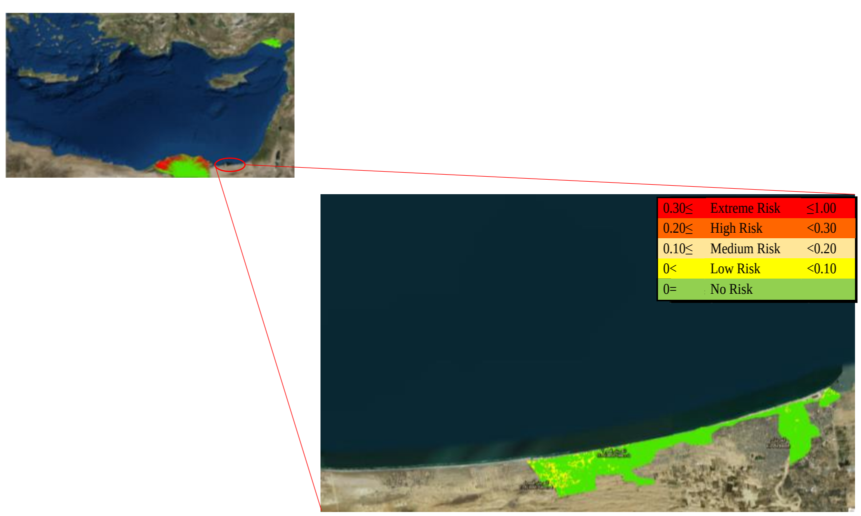

Figure D.2.2 Tsunami risk map for Al Arish City Centre

D.3 Information sheet for Alanya Coastal District

Table D.3 Economic and Social Damages Values for Alanya Coastal District

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	8164
1.00	0	0	-
2.00	561600	100	25806
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

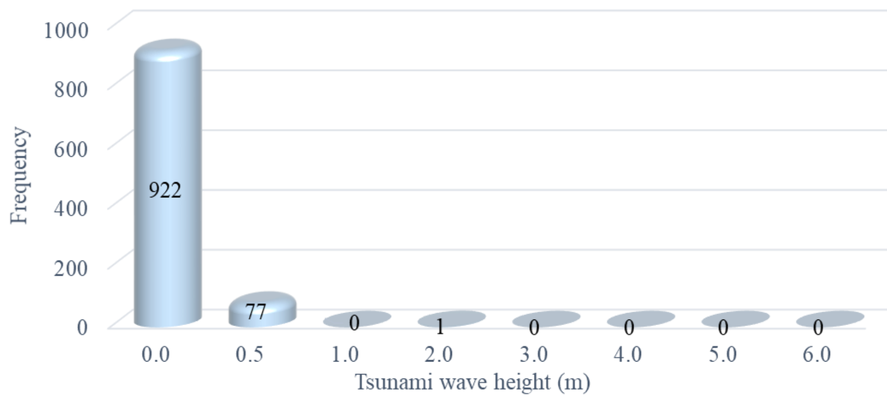

Figure D.3.1 Tsunami wave height frequency plot for Alanya Coastal District

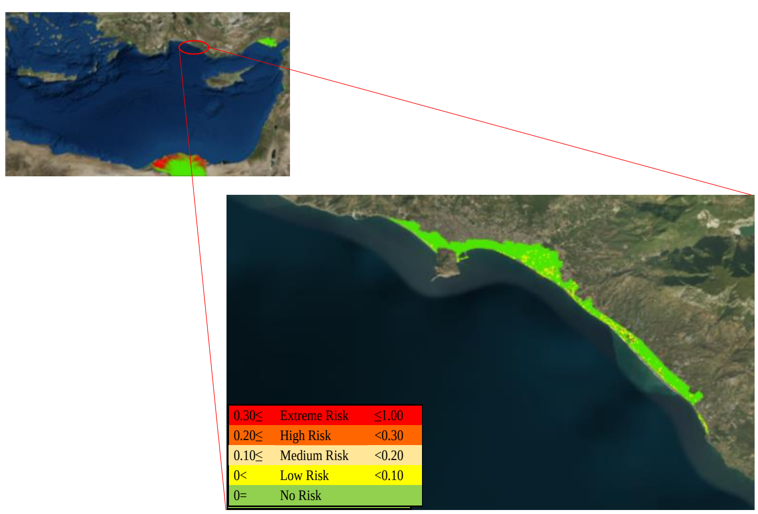

Figure D.3.2 Tsunami risk map for Alanya Coastal District

D.4 Information sheet for Alexandria City Center

Table D.4 Economic and Social Damages Values for Alexandria City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	55099
1.00	57998700	1207	110198
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

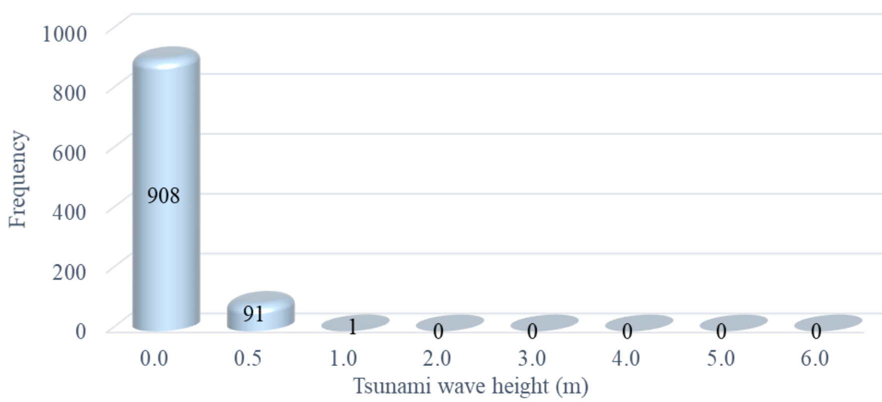

Figure D.4.1 Tsunami_wave height frequency plot for Alexandria City Center

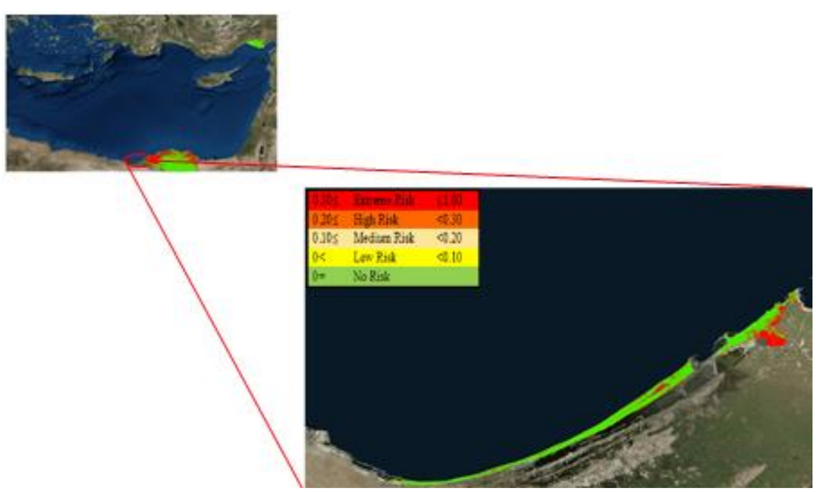

Figure D.4.2 Tsunami risk map for Alexandria City Center

D.5 Information sheet for Anamur coastal district

Table D.5 Economic and Social Damages Values for Anamur coastal district

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	29
1.00	144000	6	58
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

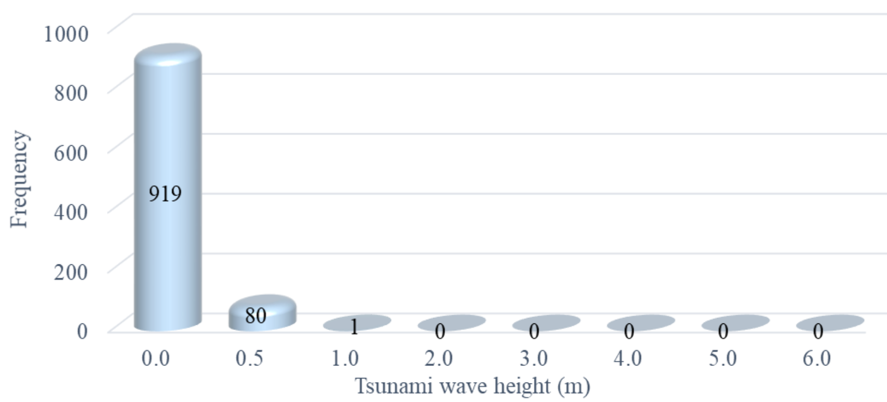

Figure D.5.1 Tsunami wave height frequency plot for Anamur coastal district

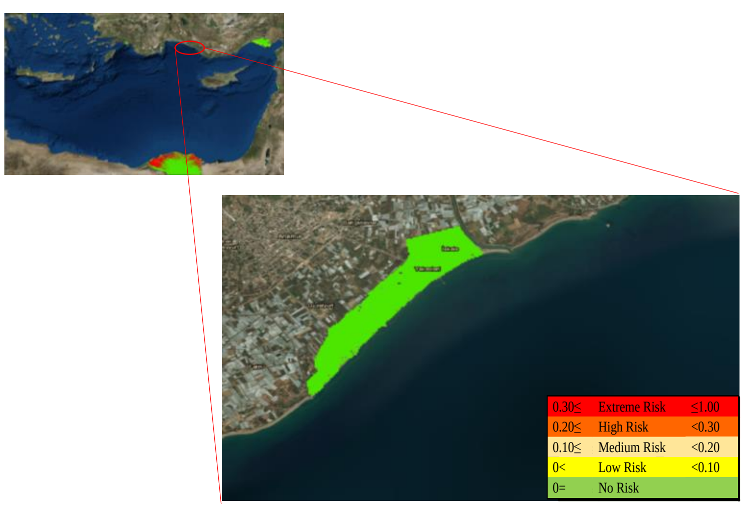

Figure D.5.21 Tsunami risk map for Anamur coastal district

D.6 Information sheet for Antalya Konyaalti

Table D.6 Economic and Social Damages Values for Antalya Konyaalti

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	390
1.00	284400	13	779
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

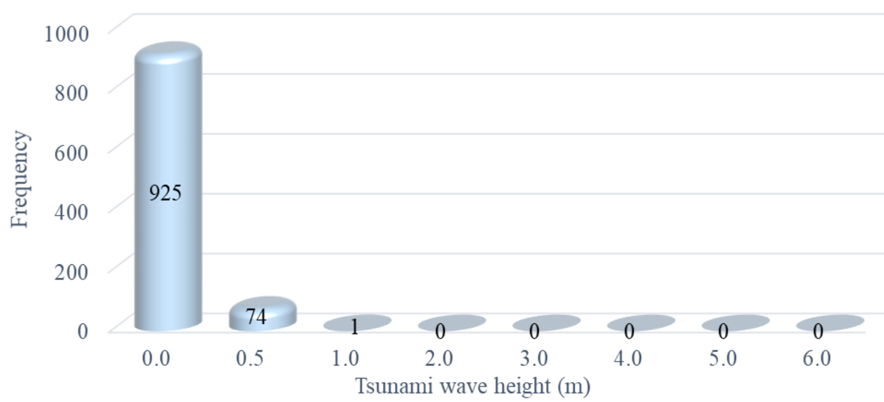

Figure D.6.1 Tsunami wave height frequency plot for Antalya Konyaalti

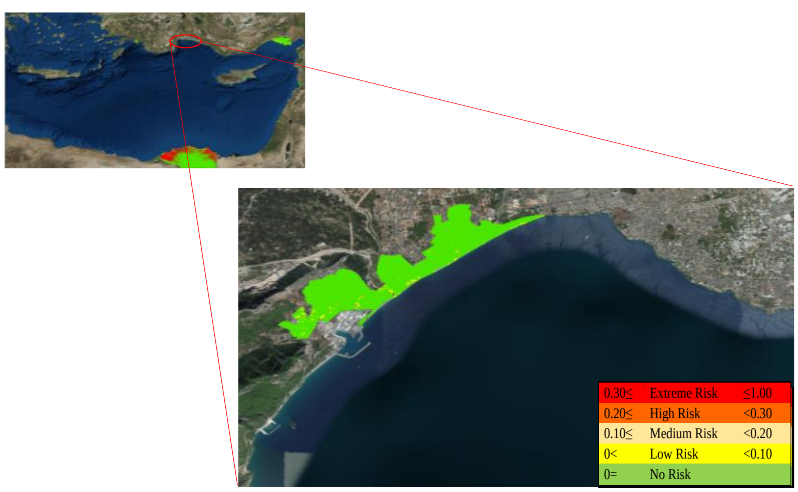

Figure D.6.2 Tsunami risk map for Antalya Konyaalti

D.7 Information sheet for Arsuz Summer Villages

Table D.7 Economic and Social Damages Values for Arsuz Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	8
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

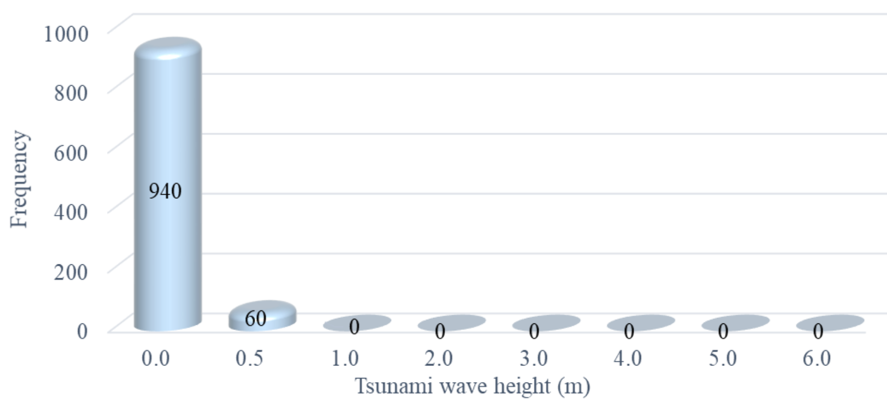

Figure D.7.1 Tsunami wave height frequency plot for Arsuz Summer Villages

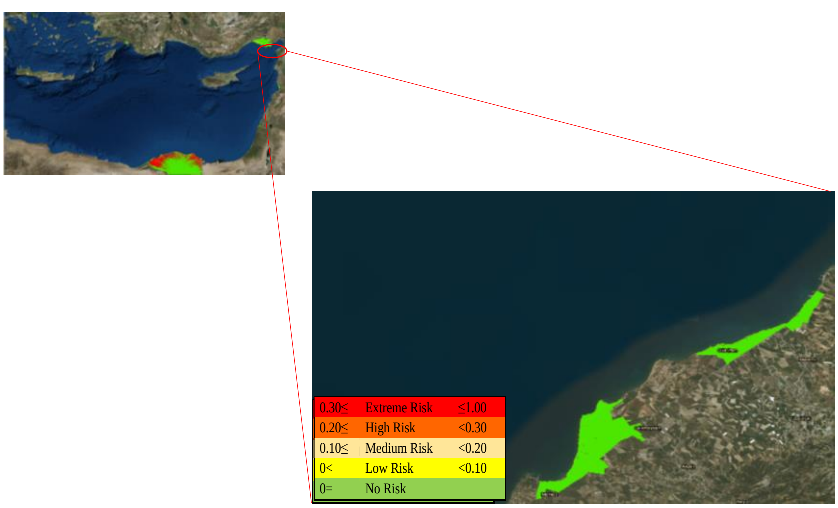

Figure D.7.2 Tsunami risk map for Arsuz Summer Villages

D.8 Information sheet for Batraun City Center

Table D.8 Economic and Social Damages Values for Batraun City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	4
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

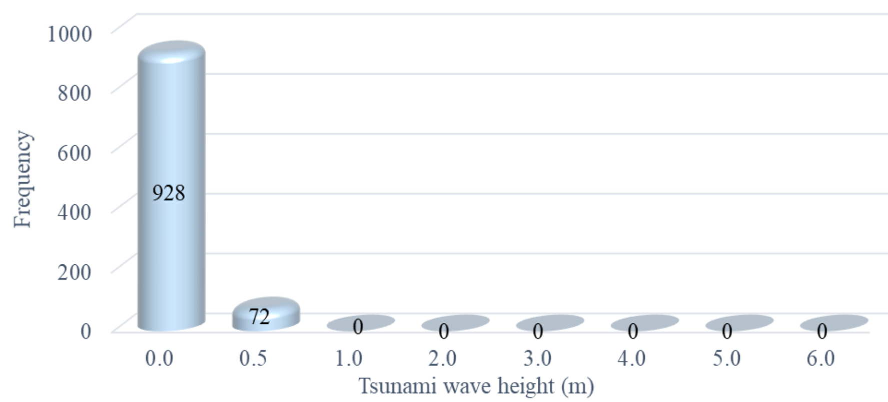

Figure D.8.1 Tsunami wave height frequency plot for Batraun City Center

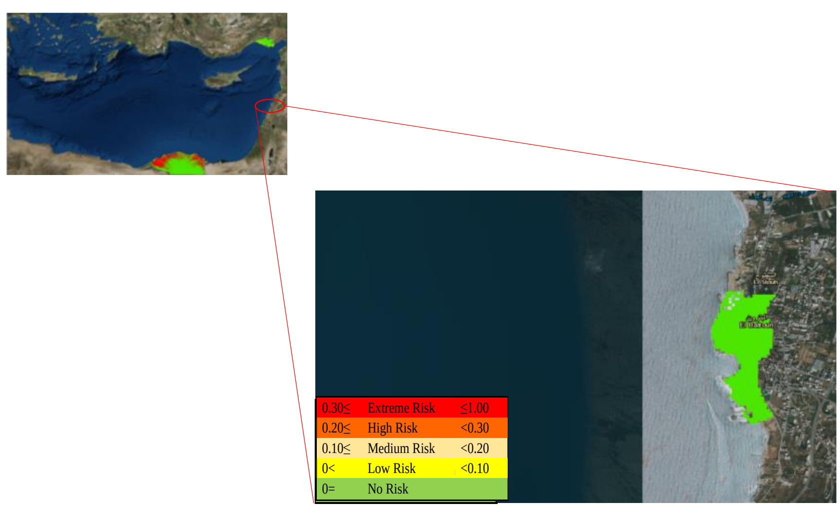

Figure D.8.2 Tsunami risk map for Batraun City Center

D.9 Information sheet for Beirut City Center

Table D.9 Economic and Social Damages Values for Beirut City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	318
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

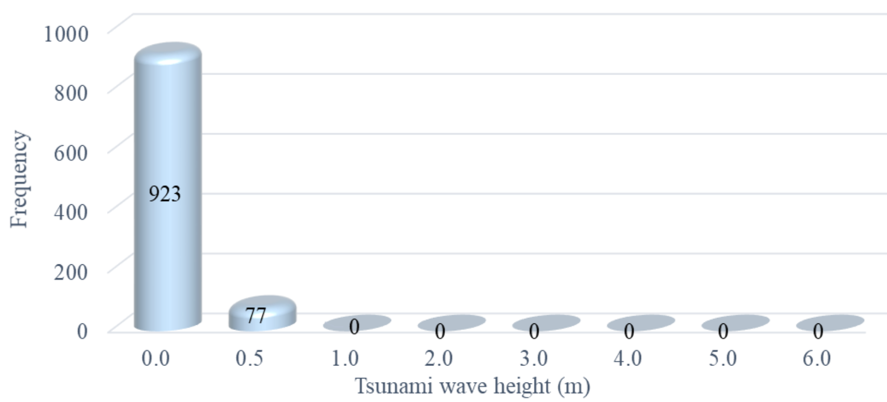

Figure D.9.1 Tsunami wave height frequency plot for Beirut City Center

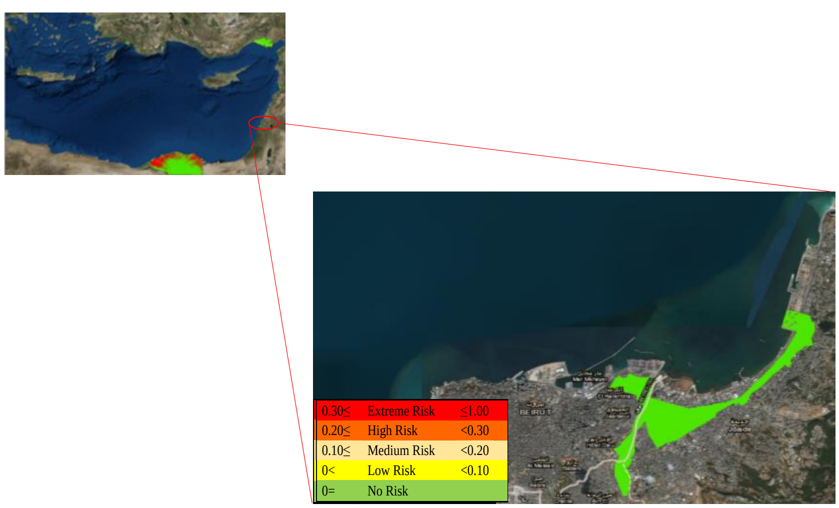

Figure D.9.2 Tsunami risk map for Beirut City Center

D.10 Information sheet for Belek Summer Villages

Table D.10 Economic and Social Damages Values for Belek Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	4198
1.00	2162700	97	9836
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

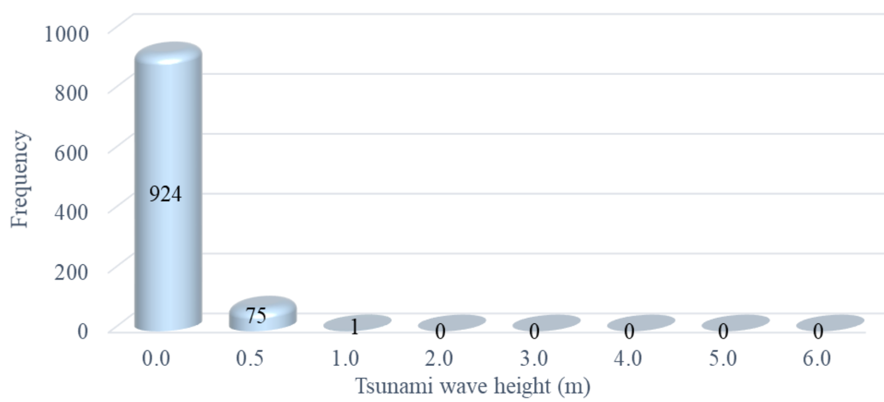

Figure D.10.1 Tsunami wave height frequency plot for Belek Summer Villages

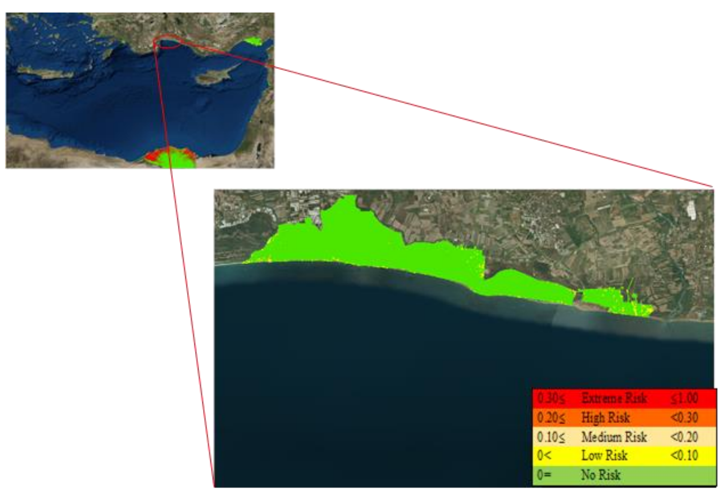

Figure D.10.2 Tsunami risk map for Belek Summer Villages

D.11 Information sheet for Crete Summer Villages

Table D.11 Economic and Social Damages Values for Crete Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	17816
1.00	1840500	97	35631
2.00	686700	200	48925
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

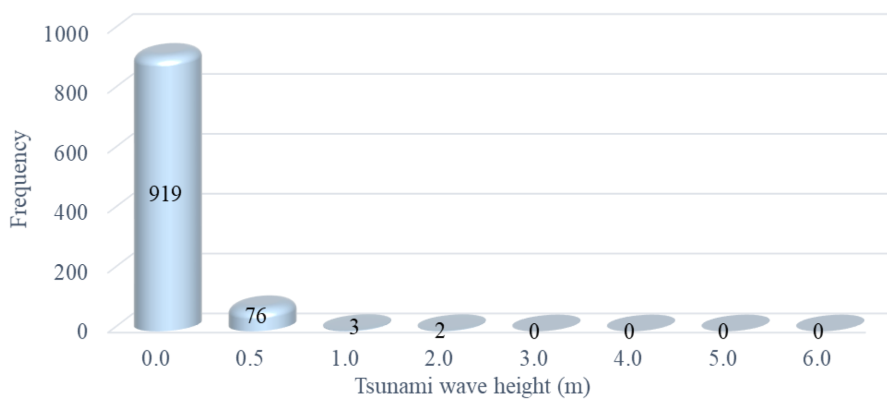

Figure D.11.1 Tsunami wave height frequency plot for Crete Summer Villages

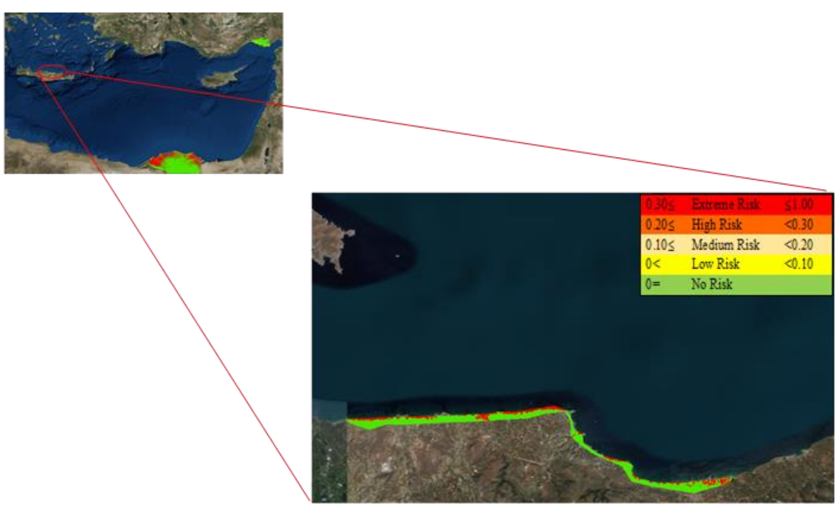

Figure D.11.2 Tsunami risk map for Crete Summer Villages

D.12 Information sheet for Dalaman City Center

Table D.12 Economic and Social Damages Values for Dalaman City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)	Inundation level (m)
0.50	0	-	-	0
1.00	0	0	0	0
2.00	0	0	0	0
3.00	0	0	0	0
4.00	0	0	0	0
5.00	0	0	0	0
6.00	0	0	0	0

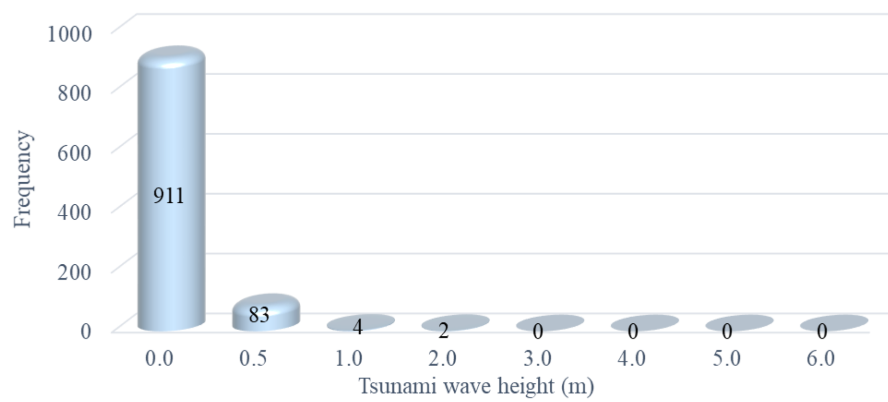

Figure D.12.1 Tsunami wave height frequency plot for Dalaman City Center

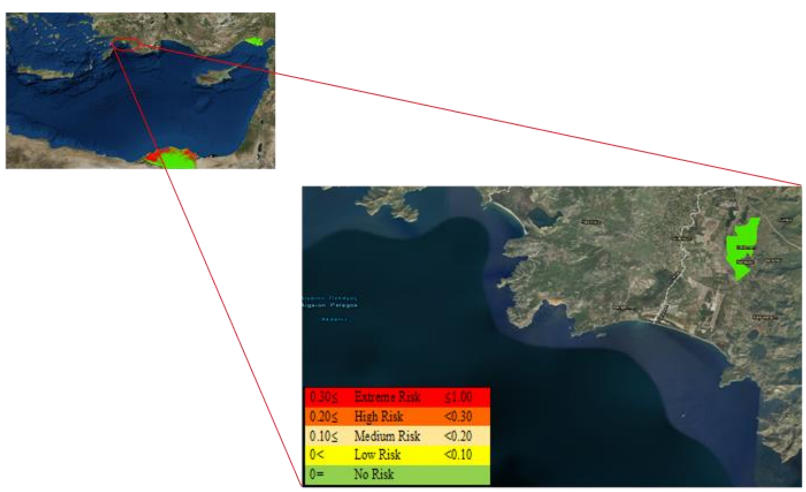

Figure D.12.2 Tsunami risk map for Dalaman City Center

D.13 Information sheet for Demre City Center

Table D.13 Economic and Social Damages Values for Demre City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	0
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

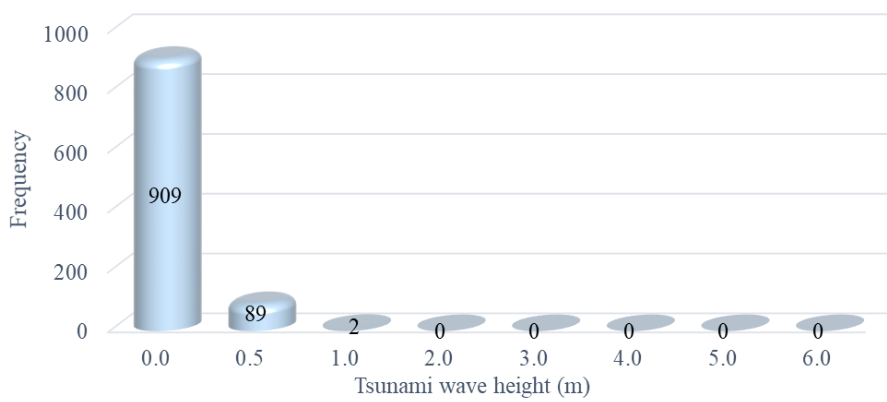

Figure D.13.1 Tsunami wave height frequency plot for Demre City Center

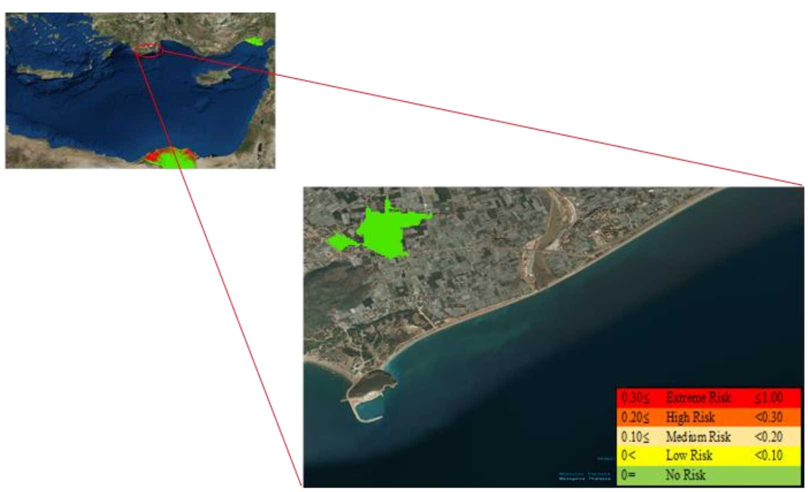

Figure D.13.2 Tsunami risk map for Demre City Center

D.14 Information sheet for Erdemli City Center

Table D.14 Economic and Social Damages Values for Erdemli City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	70
1.00	72900	3	140
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

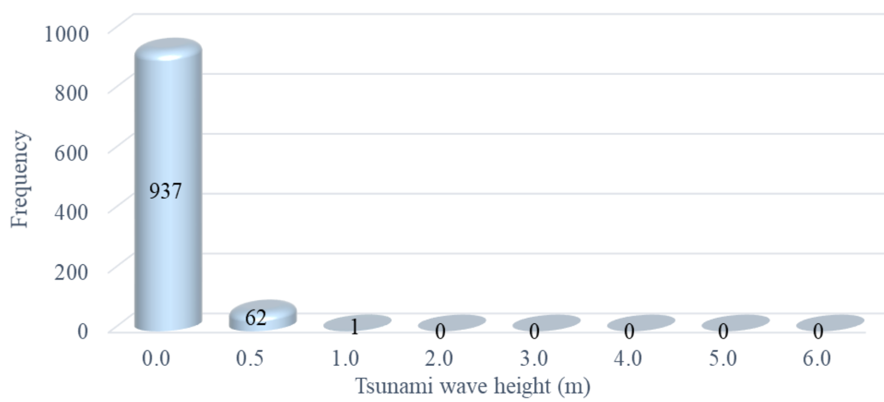

Figure D.14.1 Tsunami wave height frequency plot for Erdemli City Center

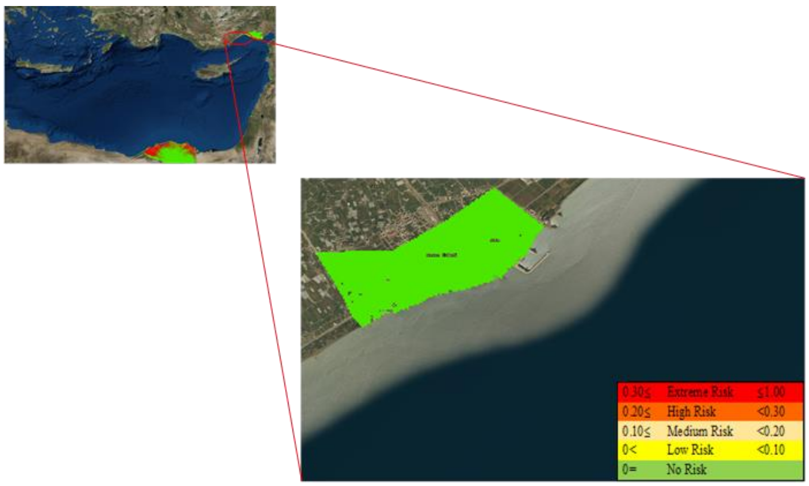

Figure D.14.2 Tsunami risk map for Erdemli City Center

D.15 Information sheet for Fethiye City Center

Table D.15 Economic and Social Damages Values for Fethiye City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1531
1.00	1222200	55	3062
2.00	819900	134	5116
3.00	0	0	0
4.00	992700	327	9657
5.00	0	0	0
6.00	0	0	0

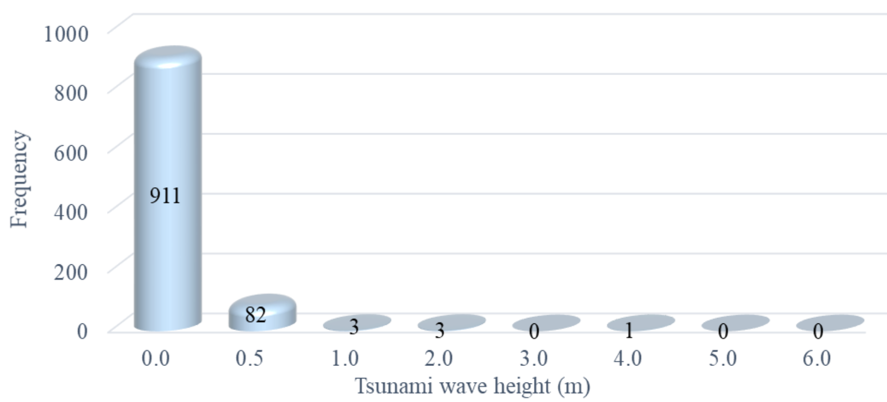

Figure D.15.1 Tsunami wave height frequency plot for Fethiye City Center

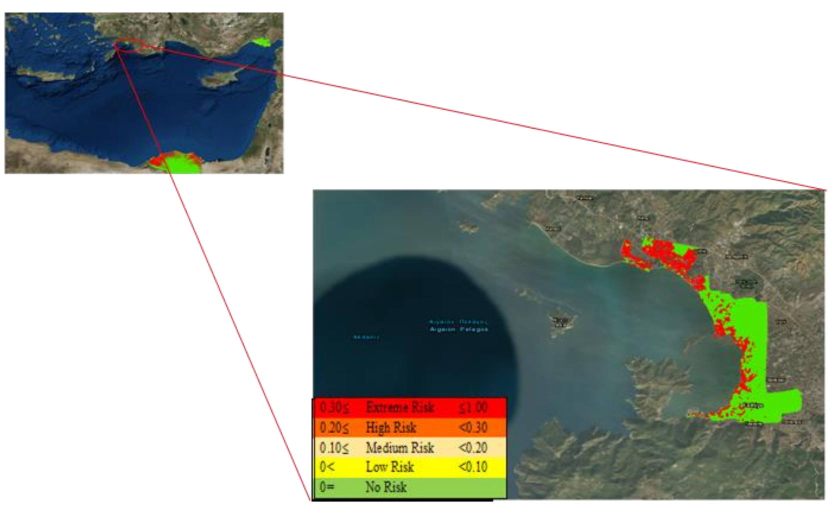

Figure D.15.2 Tsunami risk map for Fethiye City Center

D.16 Information sheet for Finike City Center

Table D.16 Economic and Social Damages Values for Finike City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	195
1.00	657000	30	389
2.00	746100	92	831
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

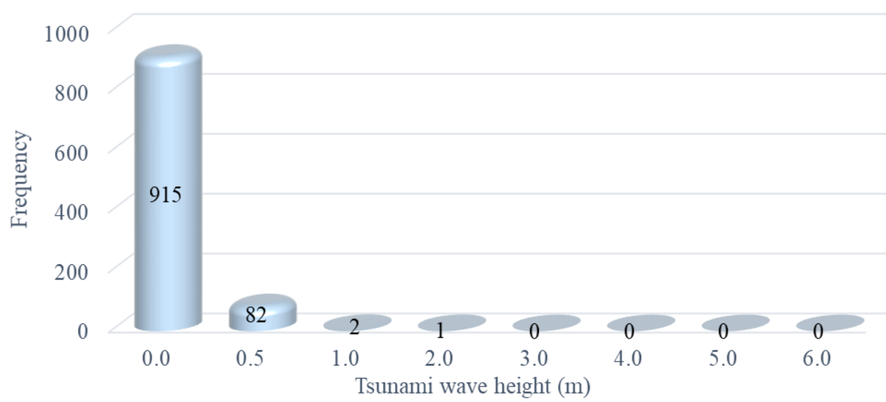

Figure D.16.1 Tsunami wave height frequency plot for Finike City Center

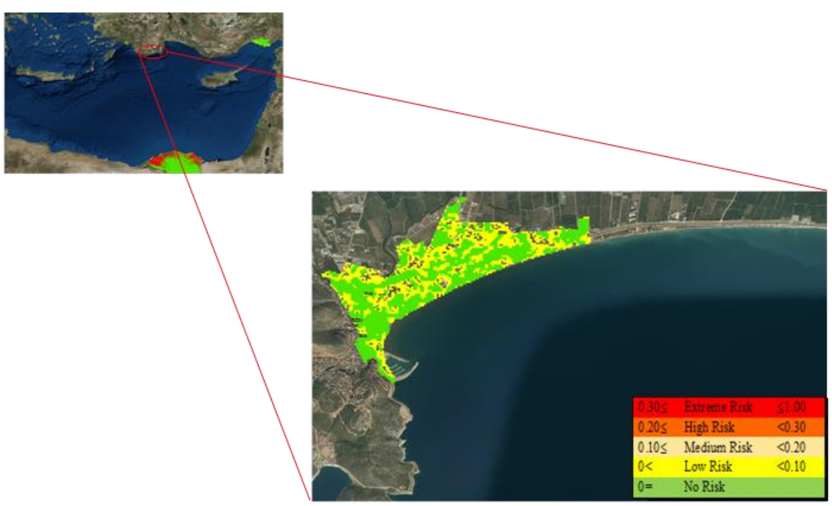

Figure D.16.2 Tsunami risk map for Finike City Center

D.17 Information sheet for Gazimagusa City Center

Table D.17 Economic and Social Damages Values for Gazimagusa City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	5
1.00	148500	8	10
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

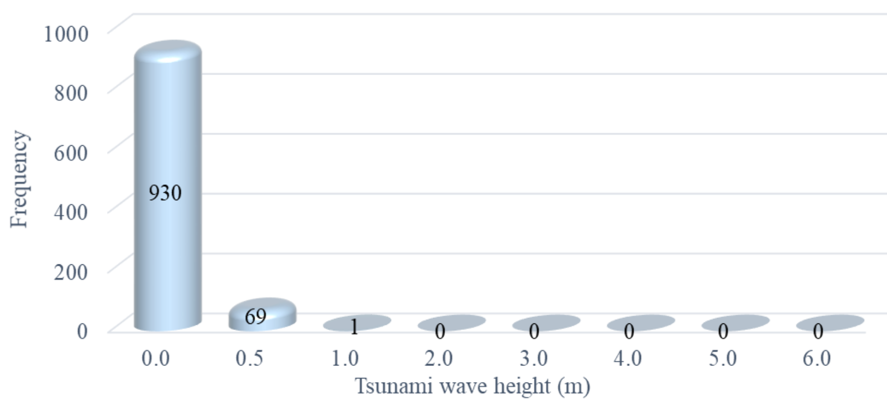

Figure D.17.1 Tsunami wave height frequency plot for Gazimagusa City Center

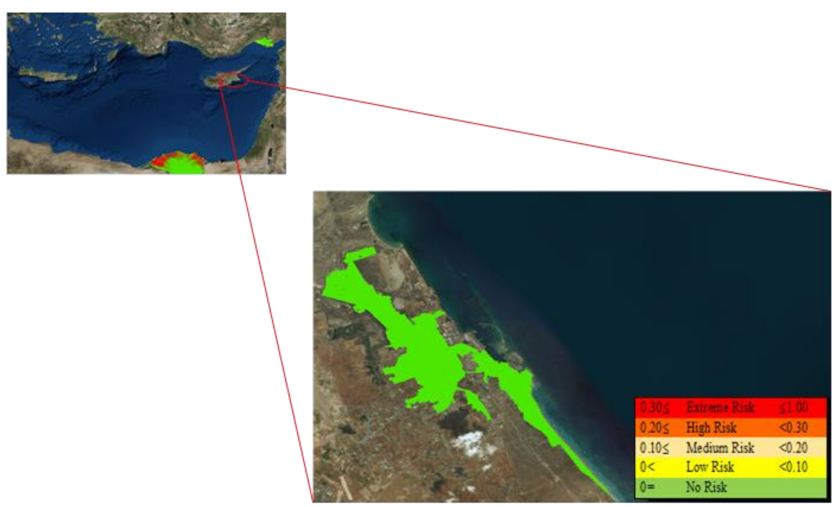

Figure D.17.2 Tsunami risk map for Gazimagusa City Center

D.18 Information sheet for Haifa City Center

Table D.18 Economic and Social Damages Values for Haifa City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3476
1.00	1670400	115	6952
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

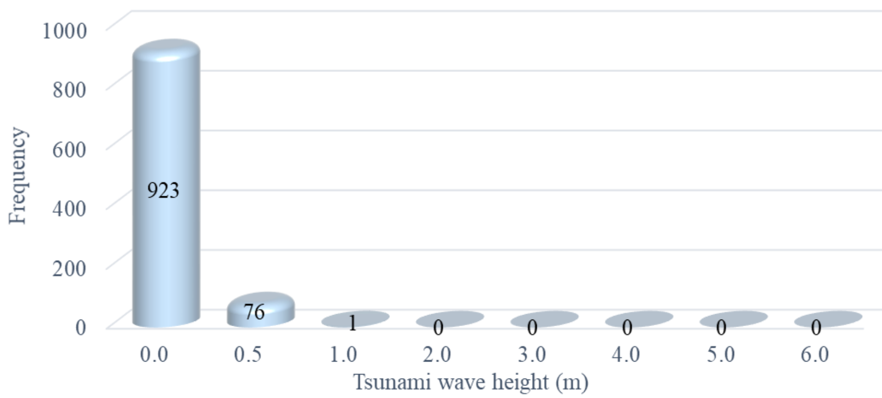

Figure D.18.1 Tsunami wave height frequency plot for Haifa City Center

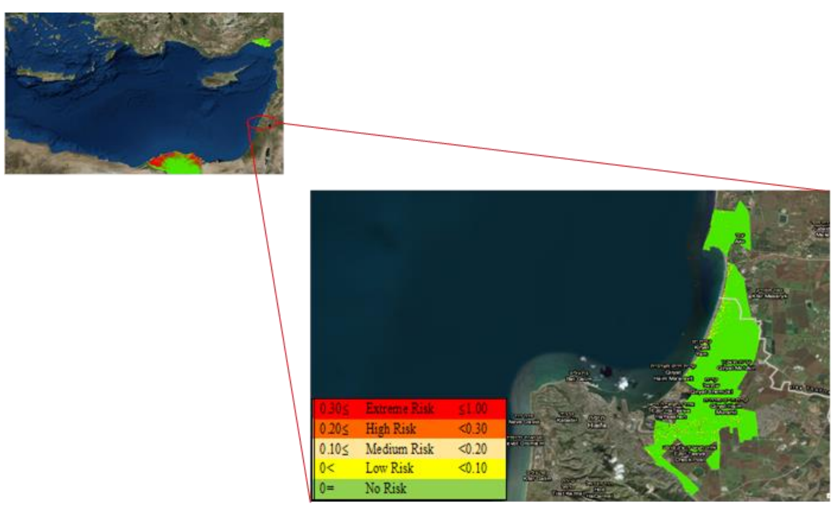

Figure D.18.2 Tsunami risk map for Haifa City Center

D.19 Information sheet for Heraklion City Center

Table D.19 Economic and Social Damages Values for Heraklion City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	512
1.00	730800	39	1023
2.00	306900	82	1453
3.00	471600	149	2113
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

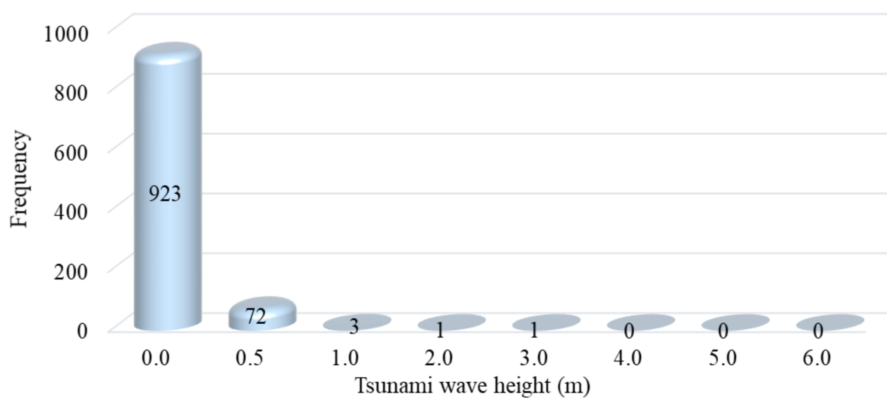

Figure D.19.1 Tsunami wave height frequency plot for Heraklion City Center

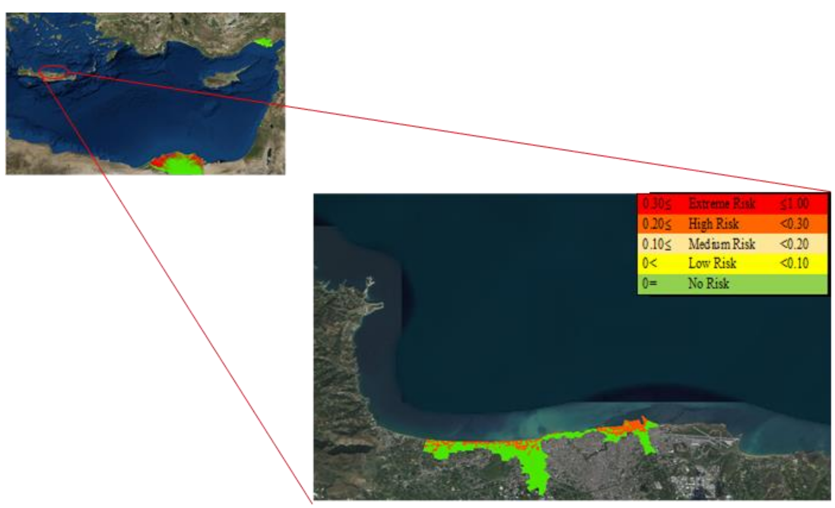

Figure D.19.2 Tsunami risk map for Heraklion City Center

D.20 Information sheet for Iskenderun City Center

Table D.20 Economic and Social Damages Values for Iskenderun City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	353
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

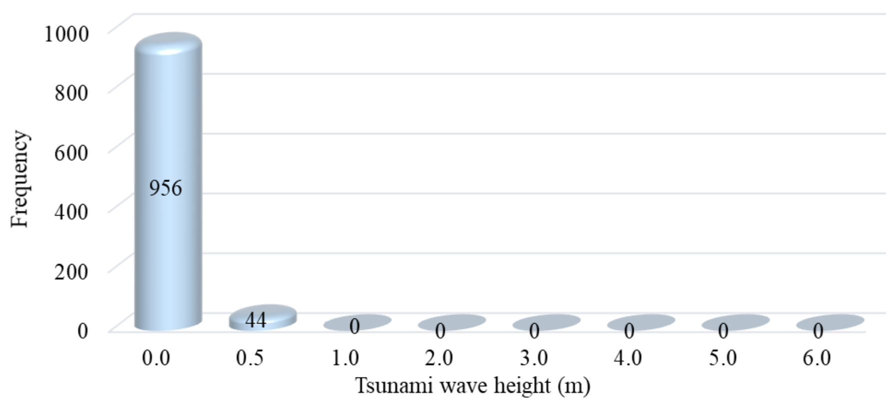

Figure D.20.1 Tsunami wave height frequency plot for Iskenderun City Center

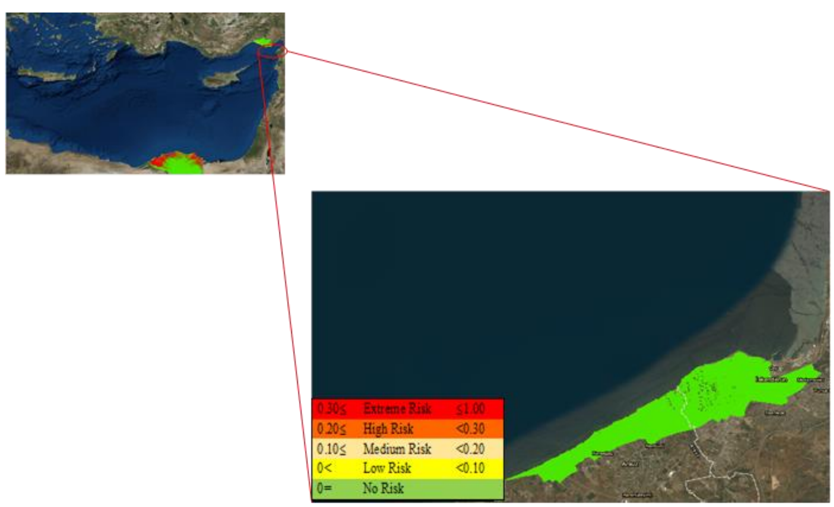

Figure D.20.2 Tsunami risk map for Iskenderun City Center

D.21 Information sheet for Kazanli City Center

Table D.21 Economic and Social Damages Values for Kazanli City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	77
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

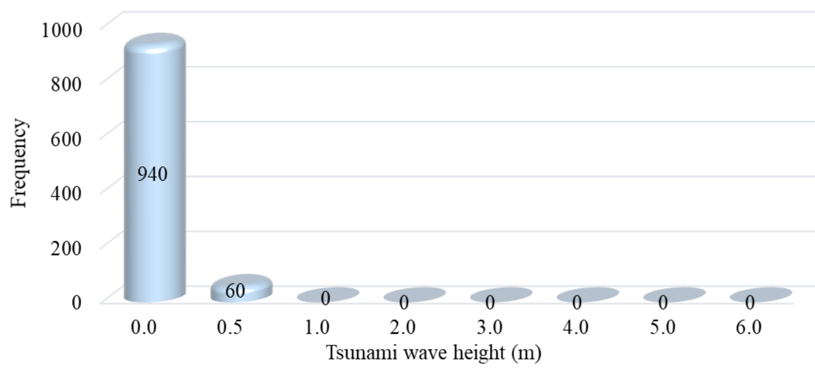

Figure D.21.1 Tsunami wave height frequency plot for Kazanli City Center

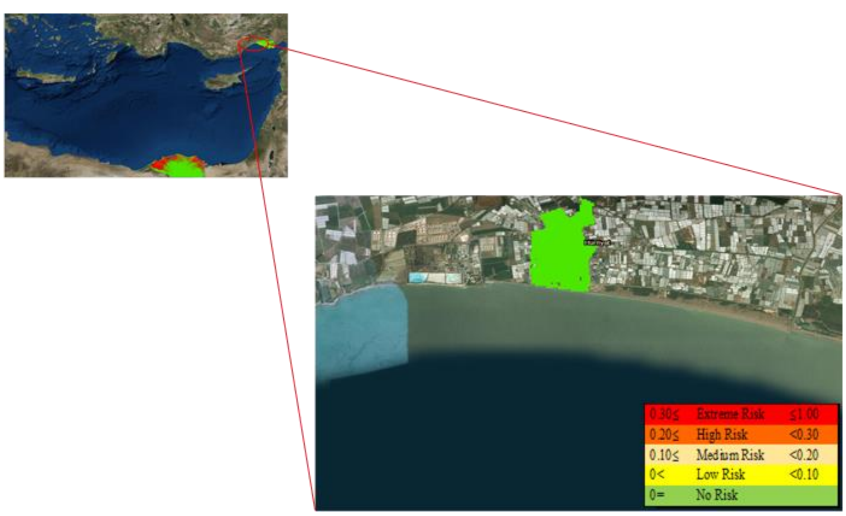

Figure D.21.2 Tsunami risk map for Kazanli City Center

D.22 Information sheet for Kemer City Center

Table D.22 Economic and Social Damages Values for Kemer City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	832
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

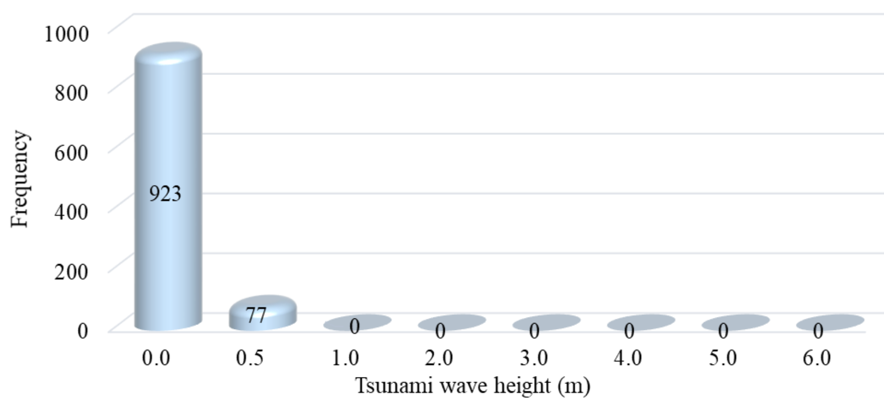

Figure D.22.1 Tsunami wave height frequency plot for Kemer City Center

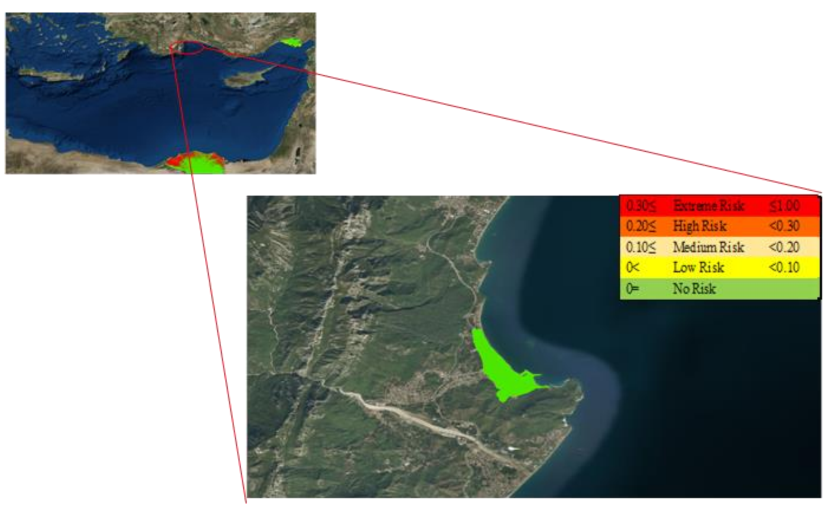

Figure D.22.2 Tsunami risk map for Kemer City Center

D.23 Information sheet for Kizkalesi Summer Villages

Table D.23 Economic and Social Damages Values for Kizkalesi Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	0
1.00	900	0	1
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

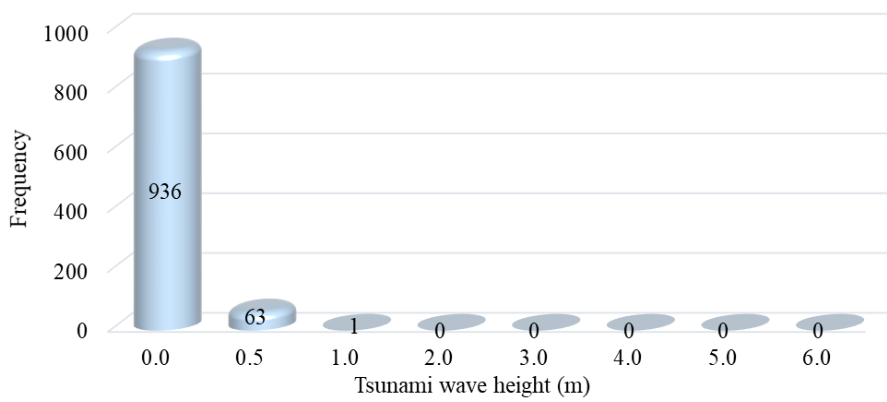

Figure D.23.1 Tsunami wave height frequency plot for Kizkalesi Summer Villages

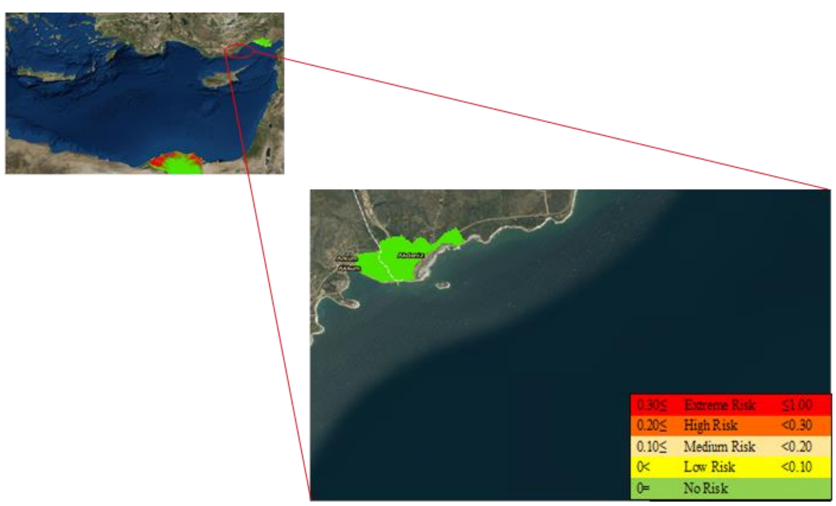

Figure D.23.2 Tsunami risk map for Kizkalesi Summer Villages

D.24 Information sheet for Larnaca City Center

Table D.24 Economic and Social Damages Values for Larnaca City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	888
1.00	683100	37	1776
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

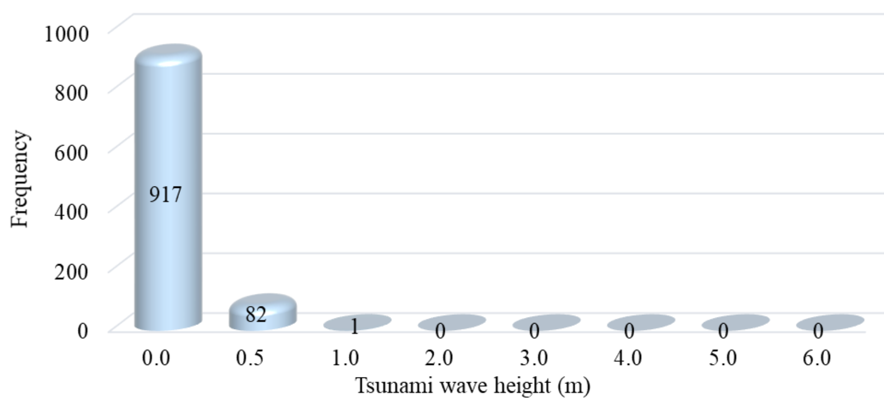

Figure D.24.1 Tsunami wave height frequency plot for Larnaca City Center

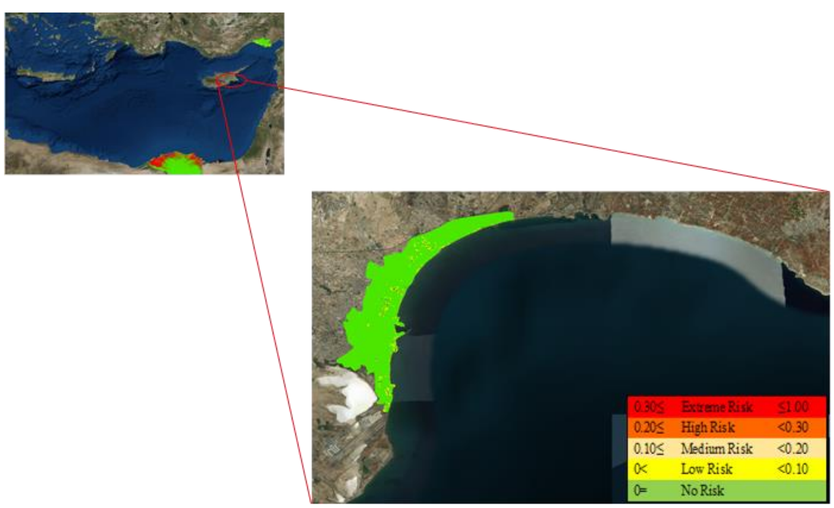

Figure D.24.2 Tsunami risk map for Larnaca City Center

D.25 Information sheet for Latakia City Center

Table D.25 Economic and Social Damages Values for Latakia City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

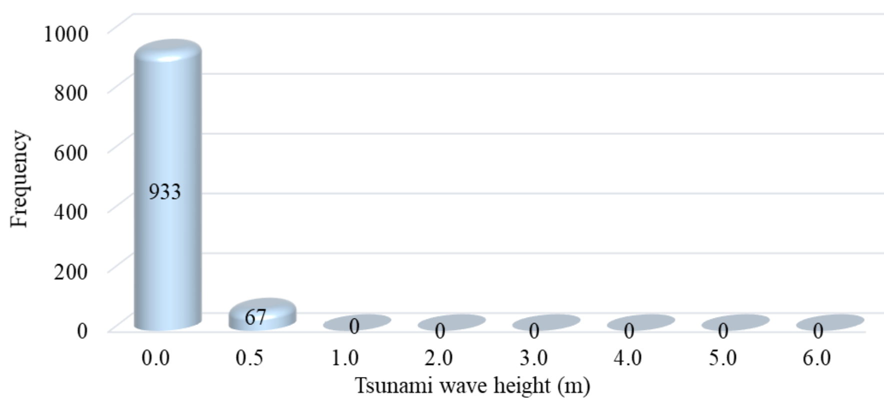

Figure D.25.1 Tsunami wave height frequency plot for Latakia City Center

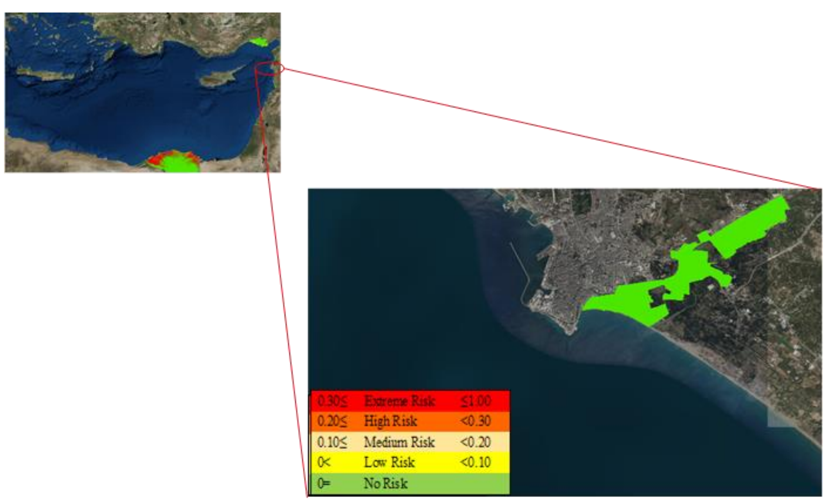

Figure D.25.2 Tsunami risk map for Latakia City Center

D.26 Information sheet for Lebanon Summer Villages

Table D.26 Economic and Social Damages Values for Lebanon Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	2480
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

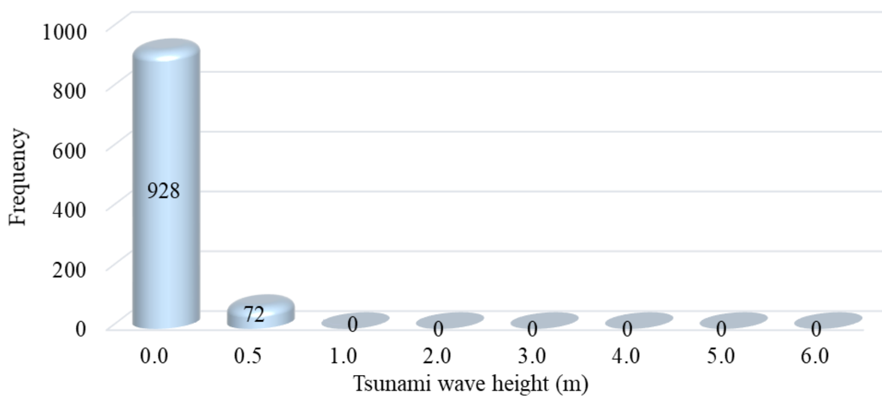

Figure D.26.1 Tsunami wave height frequency plot for Lebanon Summer Villages

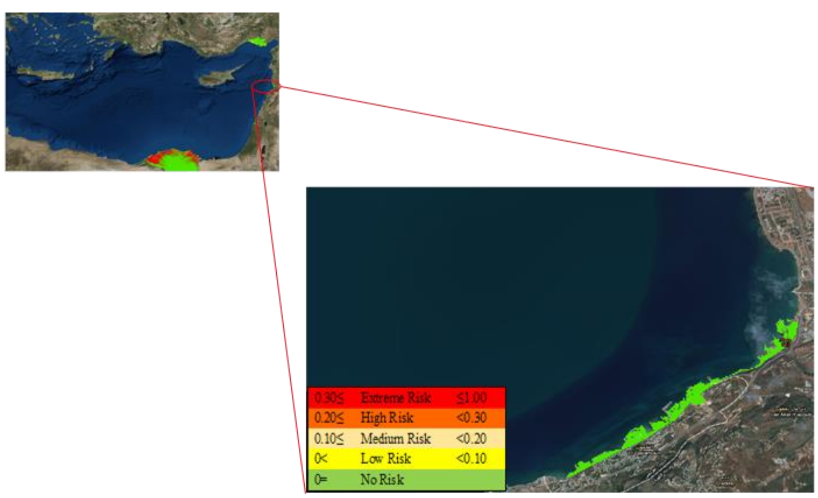

Figure D.26.2 Tsunami risk map for Lebanon Summer Villages

D.27 Information sheet for Manavgat Coastal District

Table D.27 Economic and Social Damages Values for Manavgat Coastal District

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1653
1.00	1387800	62	3305
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

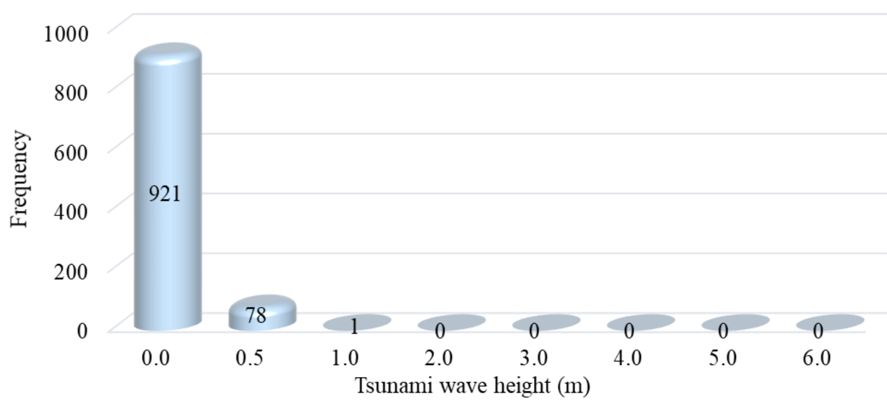

Figure D.27.1 Tsunami wave height frequency plot for Manavgat Coastal District

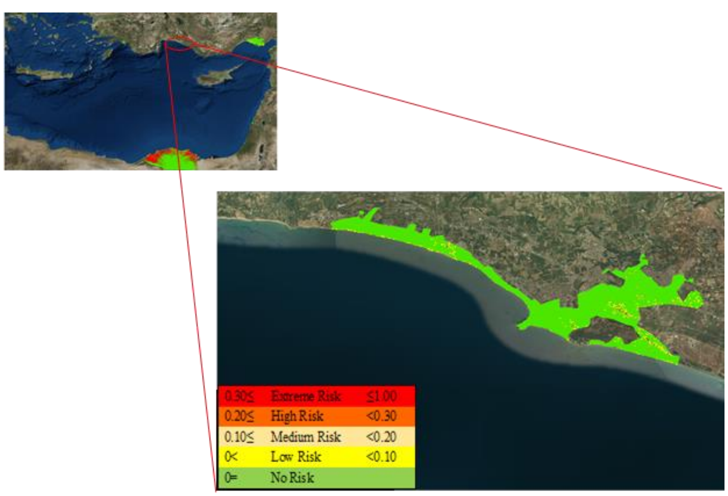

Figure D.27.2 Tsunami risk map for Manavgat Coastal District

D.28 Information sheet for Mersa Matruh City Center

Table D.28 Economic and Social Damages Values for Mersa Matruh City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	718
1.00	1009800	27	1437
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

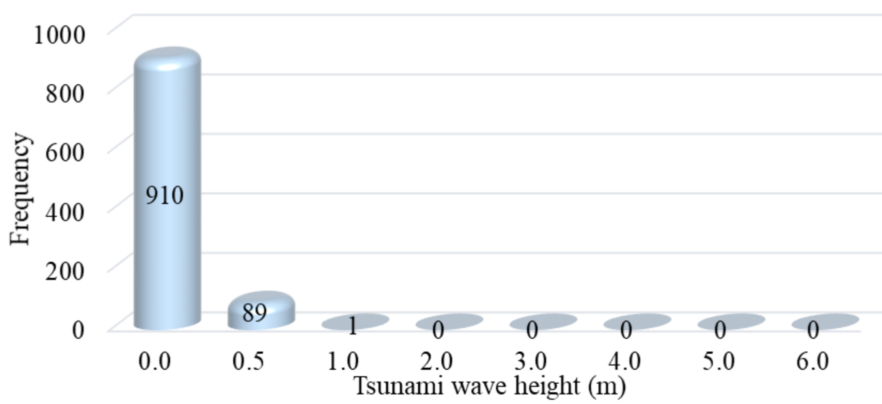

Figure D.28.1 Tsunami wave height frequency plot for Mersa Matruh City Center

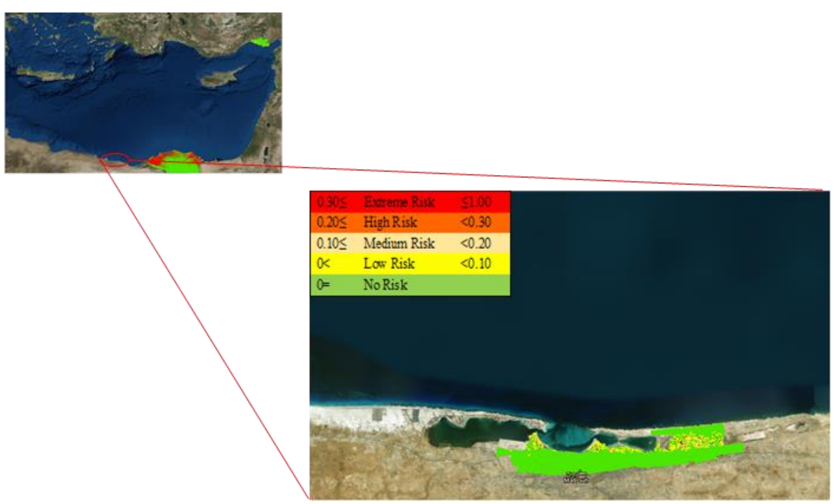

Figure D.28.2 Tsunami risk map for Mersa Matruh City Center

D.29 Information sheet for Mersin City Center

Table D.29 Economic and Social Damages Values for Mersin City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	43
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

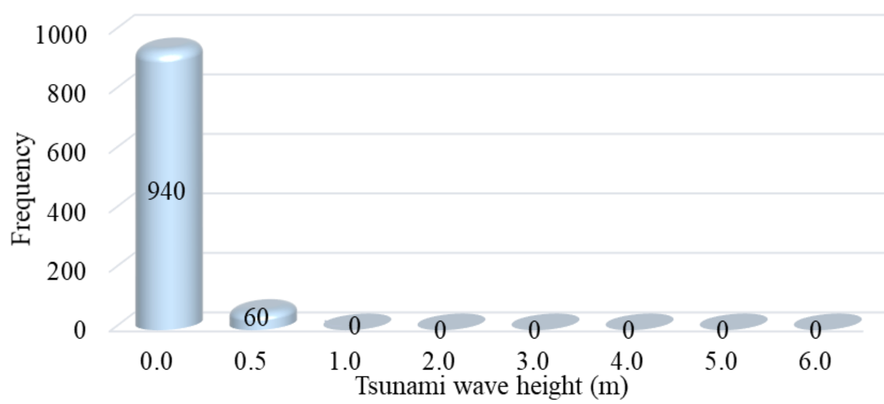

Figure D.29.1 Tsunami wave height frequency plot for Mersin City Center

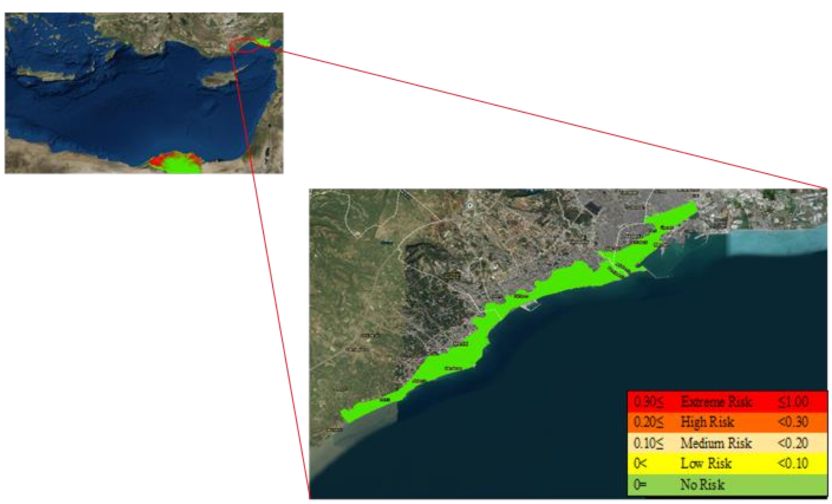

Figure D.29.2 Tsunami risk map for Mersin City Center

D.30 Information sheet for Nahariya City Center

Table D.30 Economic and Social Damages Values for Nahariya City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	466
1.00	175500	12	931
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

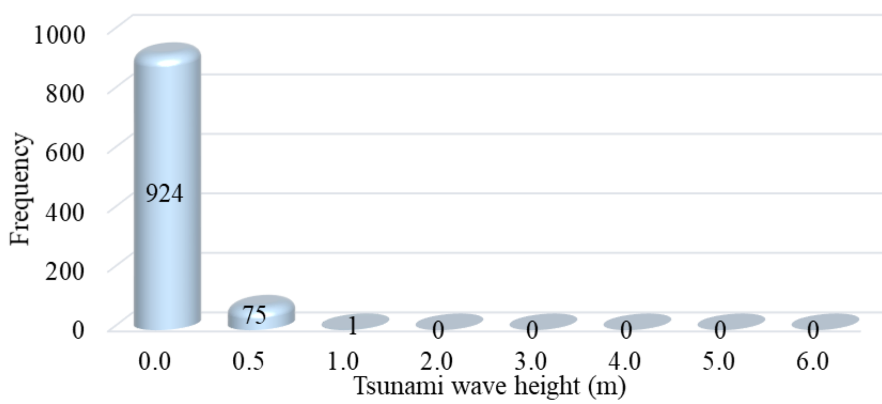

Figure D.30.1 Tsunami wave height frequency plot for Nahariya City Center

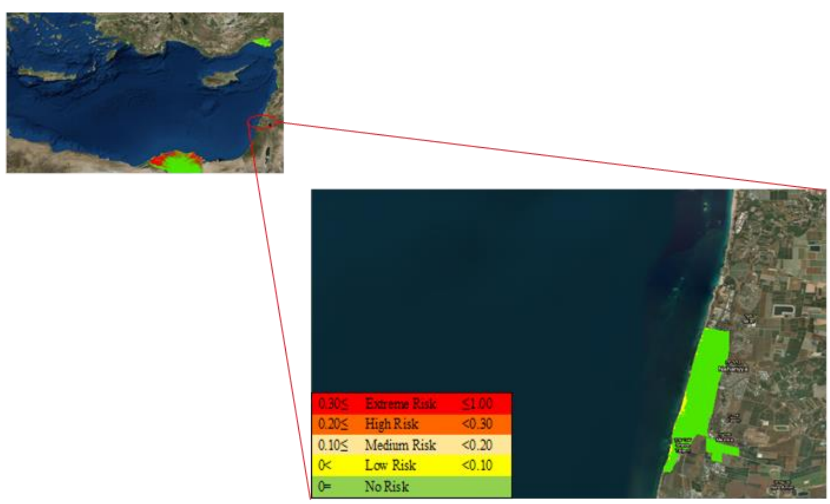

Figure D.30.2 Tsunami risk map for Nahariya City Center

D.31 Information sheet for Port Said City Center

Table D.31 Economic and Social Damages Values for Port Said City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	641
1.00	2849400	59	1282
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

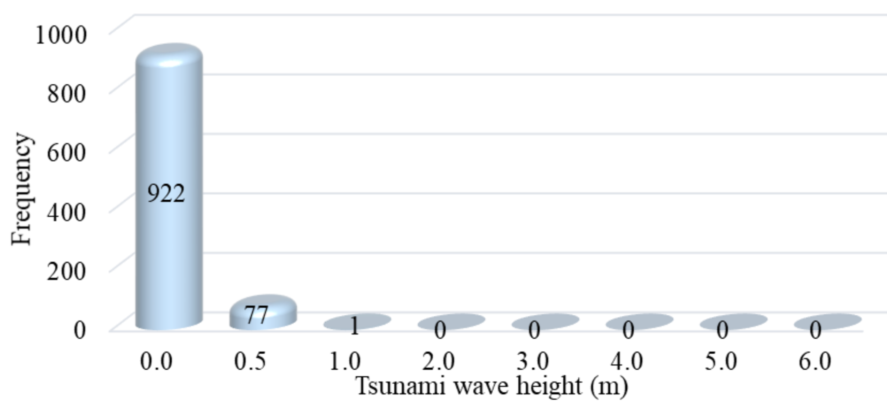

Figure D.31.1 Tsunami wave height frequency plot for Port Said City Center

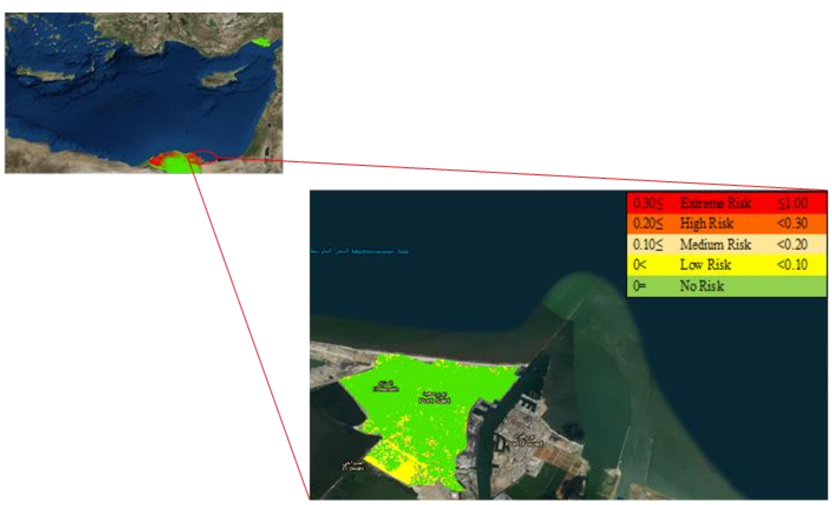

Figure D.31.2 Tsunami risk map for Port Said City Center

D.32 Information sheet for Samandag City Center

Table D.32 Economic and Social Damages Values for Samandag City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1
1.00	8100	0.4	2
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

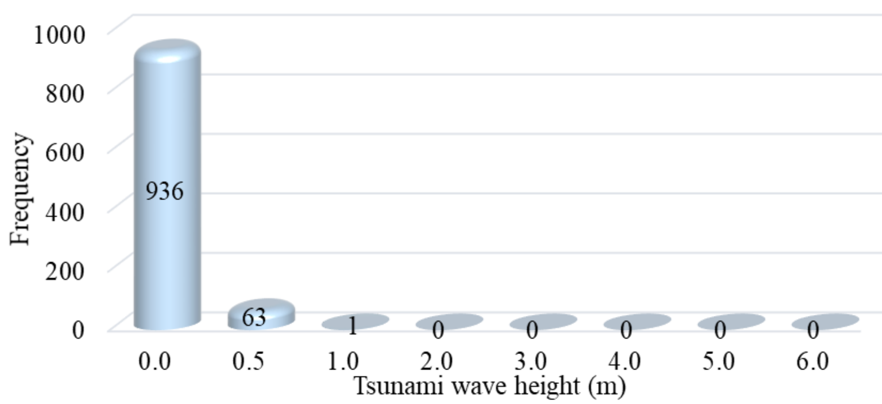

Figure D.32.1 Tsunami wave height frequency plot for Samandag City Center

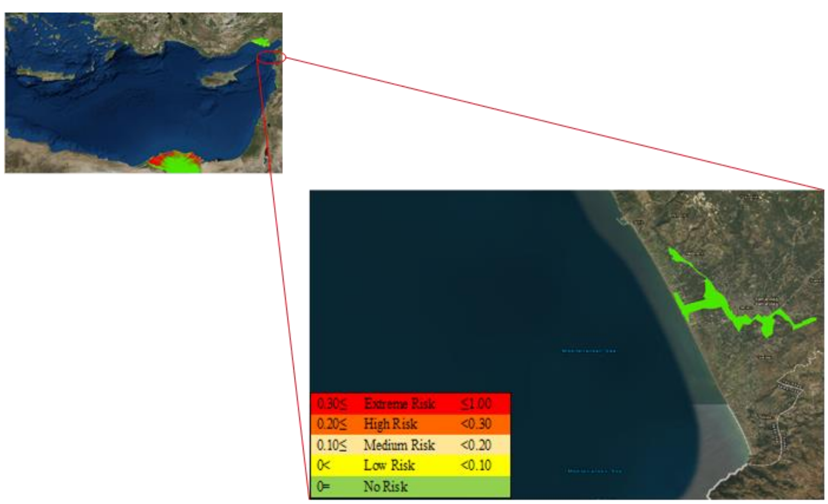

Figure D.32.2 Tsunami risk map for Samandag City Center

D.33 Information sheet for Sariseki City Center

Table D.33 Economic and Social Damages Values for Sariseki City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	0
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

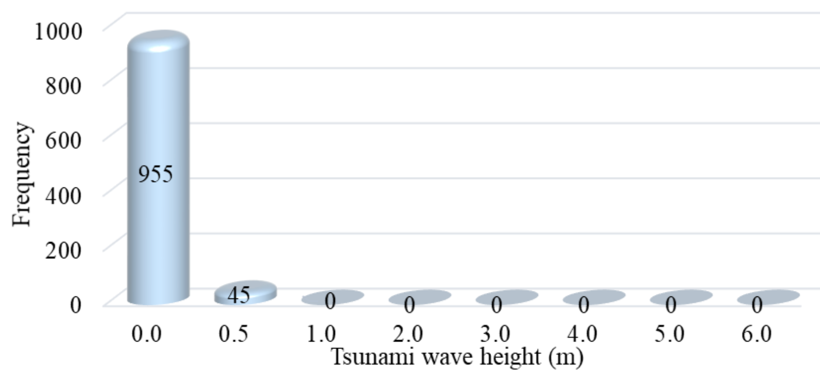

Figure D.33.1 Tsunami wave height frequency plot for Sariseki City Center

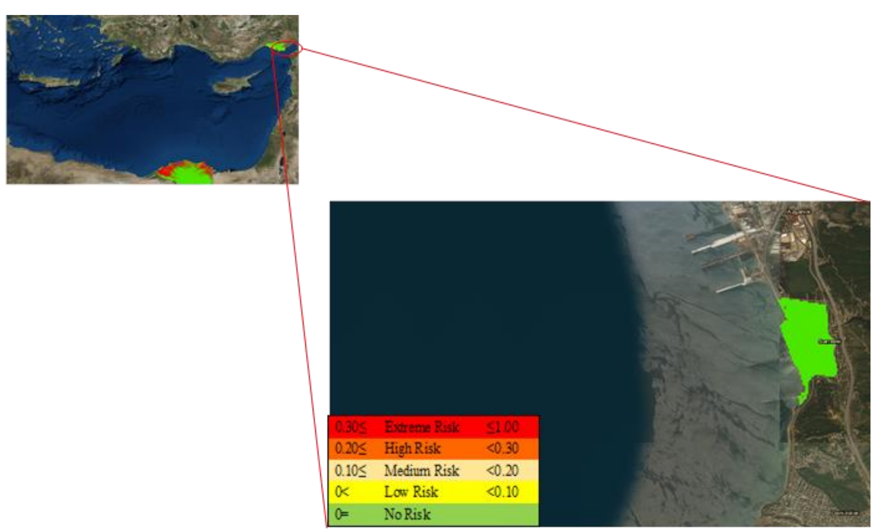

Figure D.33.2 Tsunami risk map for Sariseki City Center

D.34 Information sheet for Susanoglu Summer Villages

Table D.34 Economic and Social Damages Values for Susanoglu Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3783
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

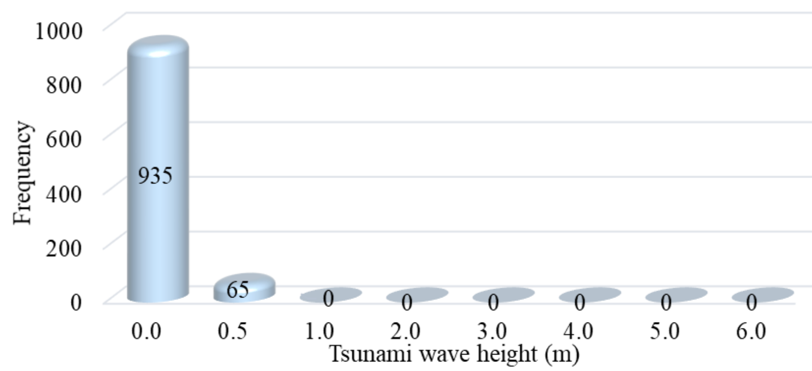

Figure D.34.1 Tsunami wave height frequency plot for Susanoglu Summer Villages

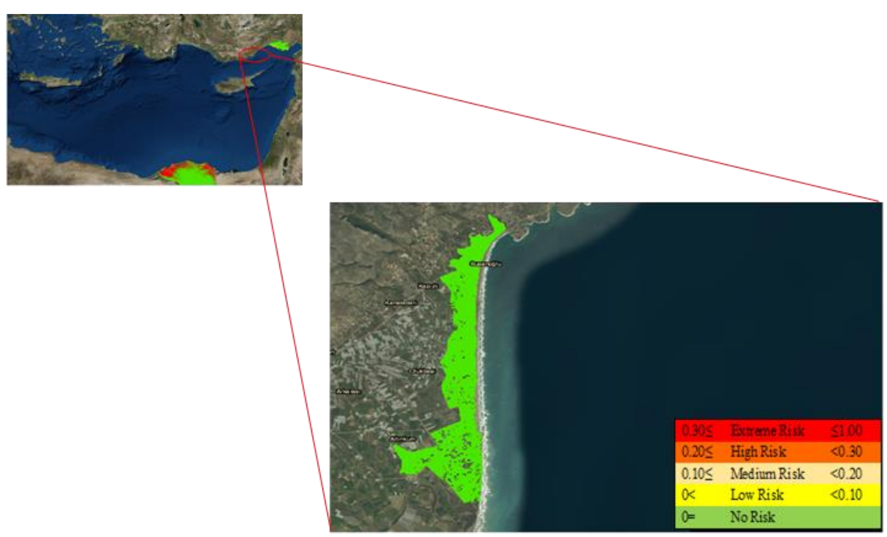

Figure D.34.2 Tsunami risk map for Susanoglu Summer Villages

D.35 Information sheet for Tartus City Center

Table D.35 Economic and Social Damages Values for Tartus City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3783
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

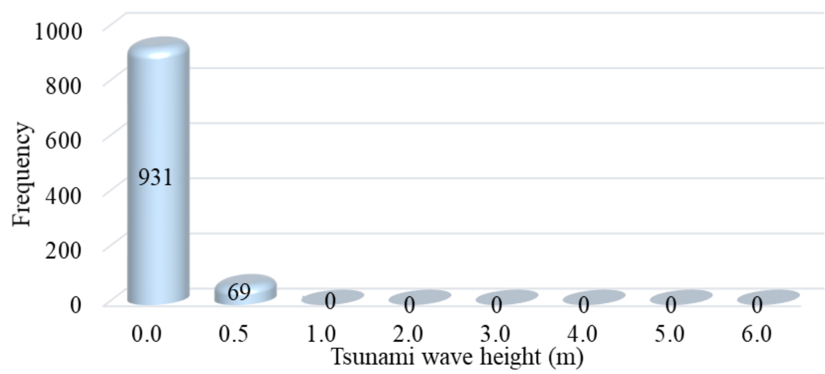

Figure D.35.1 Tsunami wave height frequency plot for Tartus City Center

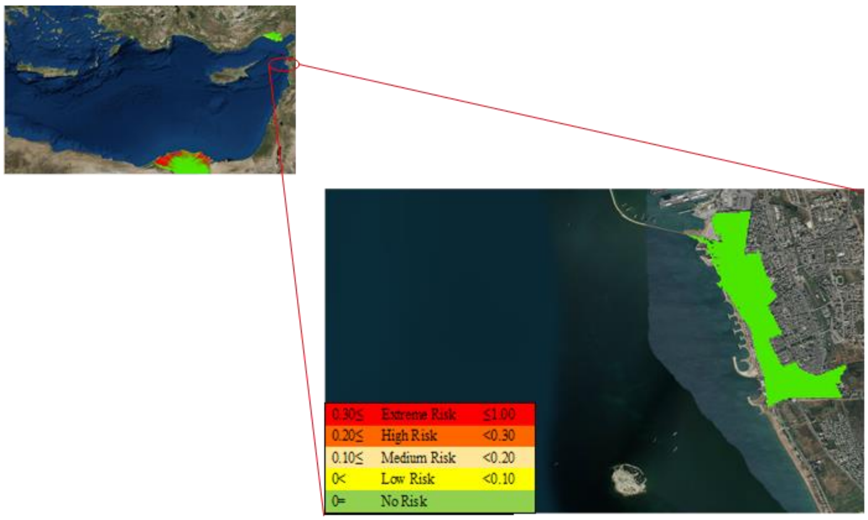

Figure D.35.2 Tsunami risk map for Tartus City Center

D.36 Information sheet for Tartus Summer Villages

Table D.36 Economic and Social Damages Values for Tartus Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	9
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

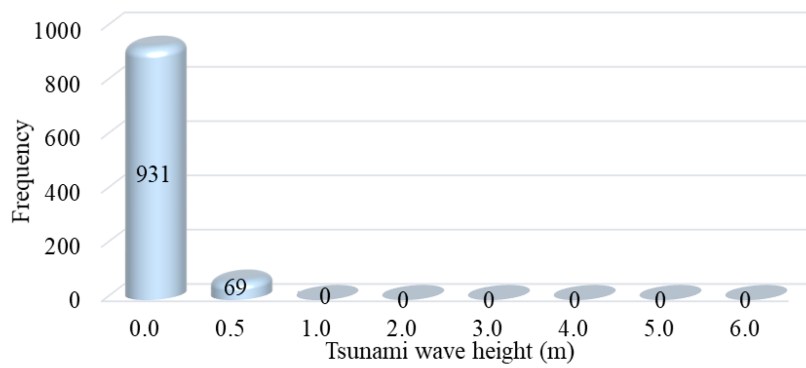

Figure D.36.1 Tsunami wave height frequency plot for Tartus Summer Villages

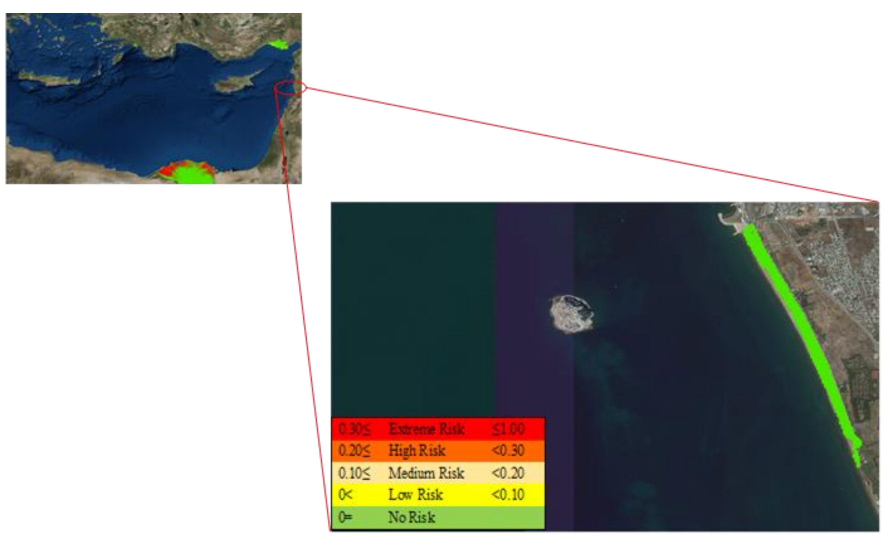

Figure D.36.2 Tsunami risk map for Tartus Summer Villages

D.37 Information sheet for Tasucu City Center

Table D.37 Economic and Social Damages Values for Tasucu City Center

Inundation level (m)	Affected area (m^2)	Economic damage (1*10^6€)	Social damage (NP)
0.50	-	-	6
1.00	253800	11	11
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

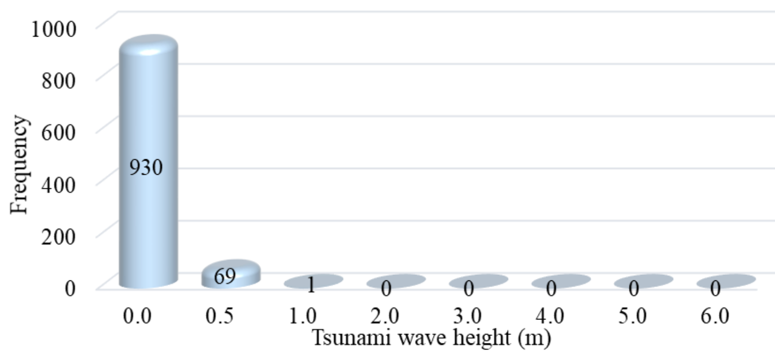

Figure D.37.1 Tsunami wave height frequency plot for Tasucu City Center

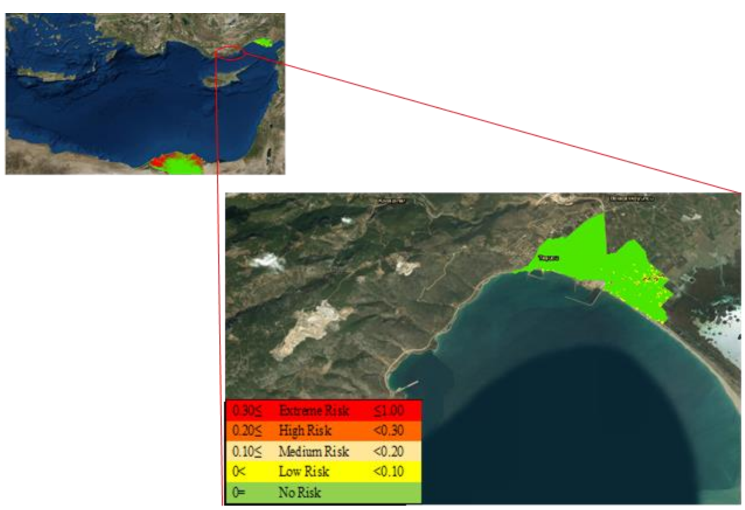

Figure D.37.2 Tsunami risk map for Tasucu City Center

D.38 Information sheet for Tel Aviv City Center

Table D.38 Economic and Social Damages Values for Tel Aviv City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	192
1.00	45900	3	383
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

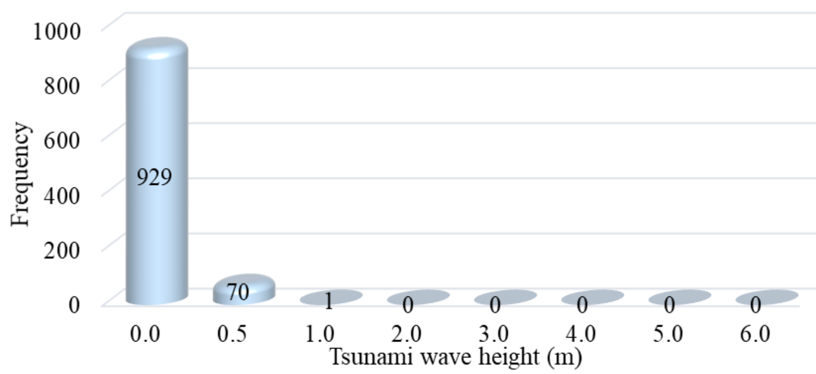

Figure D.38.1 Tsunami wave height frequency plot for Tel Aviv City Center

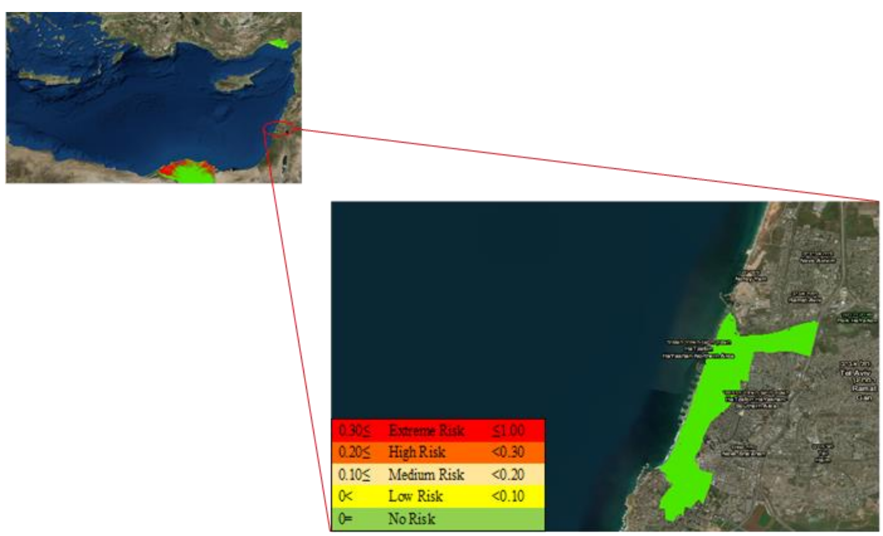

Figure D.38.2 Tsunami risk map for Tel Aviv City Center

D.39 Information sheet for Tripoli City Center

Table D.39 Economic and Social Damages Values for Tripoli City Center

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1658
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

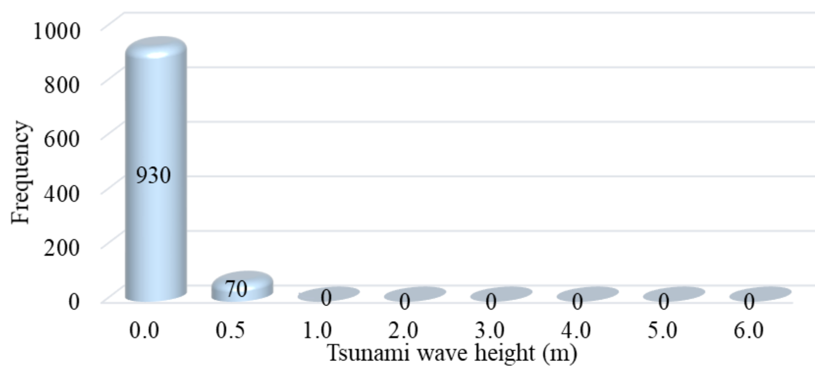

Figure D.39.1 Tsunami wave height frequency plot for Tripoli City Center

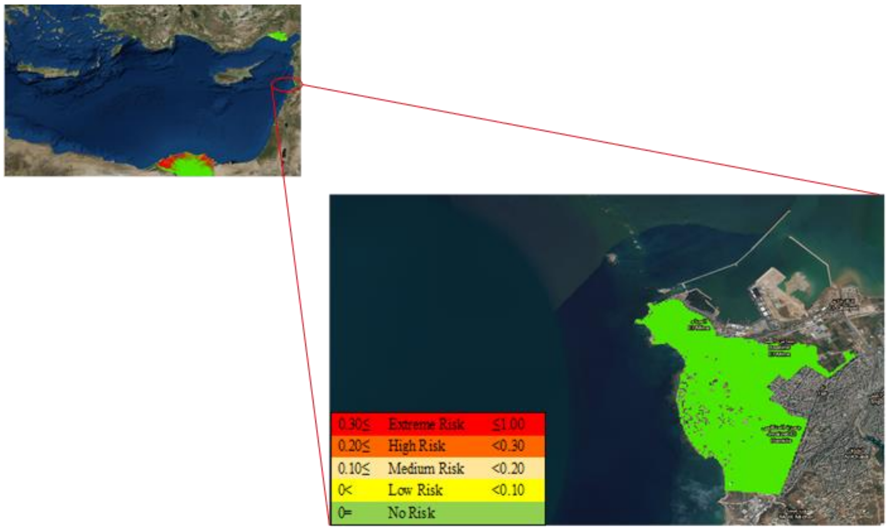

Figure D.39.2 Tsunami risk map for Tripoli City Center

D.40 Information sheet for Turkler Summer Villages

Table D.40 Economic and Social Damages Values for Turkler Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	670
1.00	331200	15	1339
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

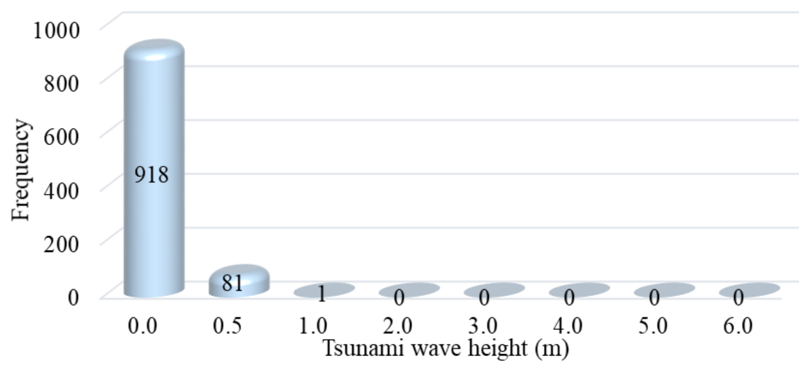

Figure D.40.1 Tsunami wave height frequency plot for Turkler Summer Villages

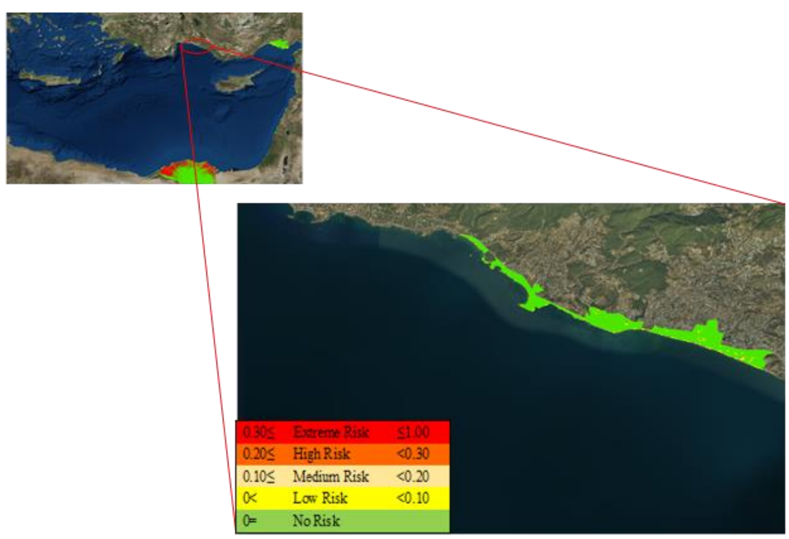

Figure D.40.2 Tsunami risk map for Turkler Summer Villages

D.41 Information sheet for Yemiskumu Summer Villages

Table D.41 Economic and Social Damages Values for Yemiskumu Summer Villages

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	8
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

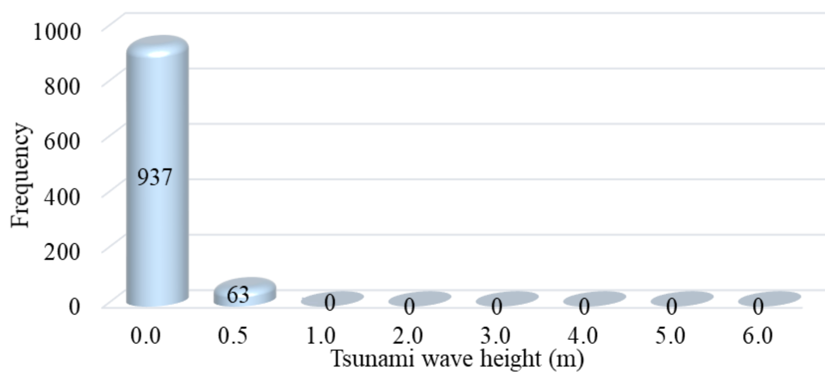

Figure D.41.1 Tsunami wave height frequency plot for Yemiskumu Summer Villages

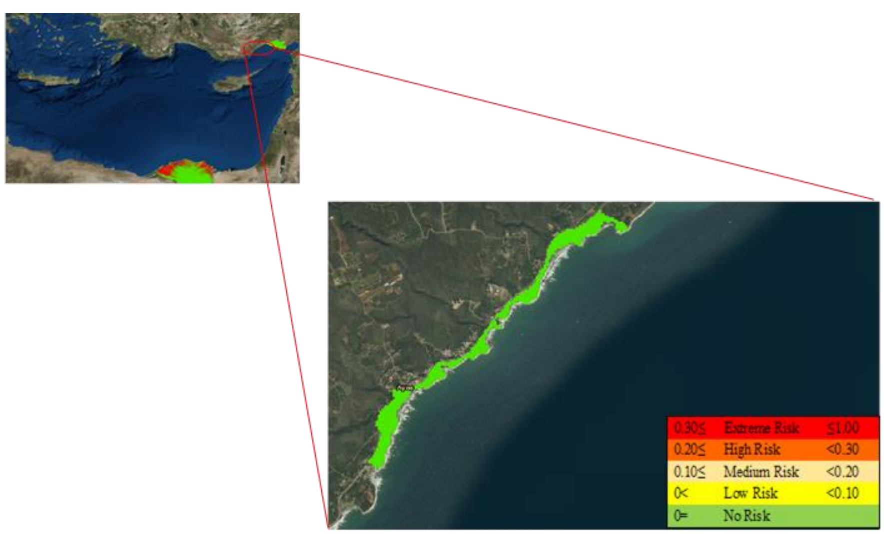

Figure D.41.2 Tsunami risk map for Yemiskumu Summer Villages

D.42 Information sheet for Abu Qir Industrial Zone

Table D.42 Economic and Social Damages Values for Abu Qir Industrial Zone

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1181
1.00	765900	21	2363
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

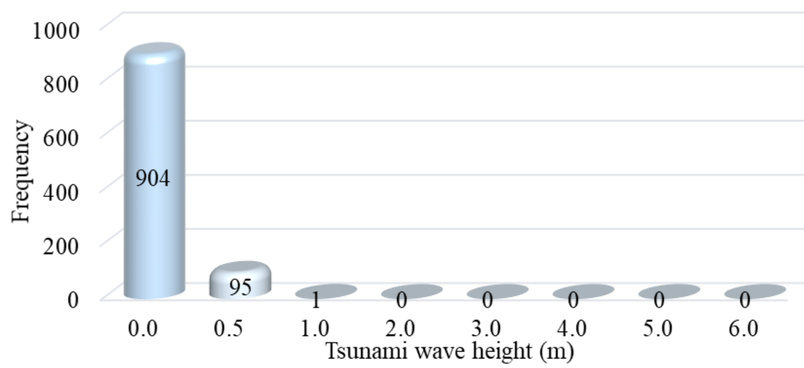

Figure D.42.1 Tsunami wave height frequency plot for Abu Qir Industrial Zone

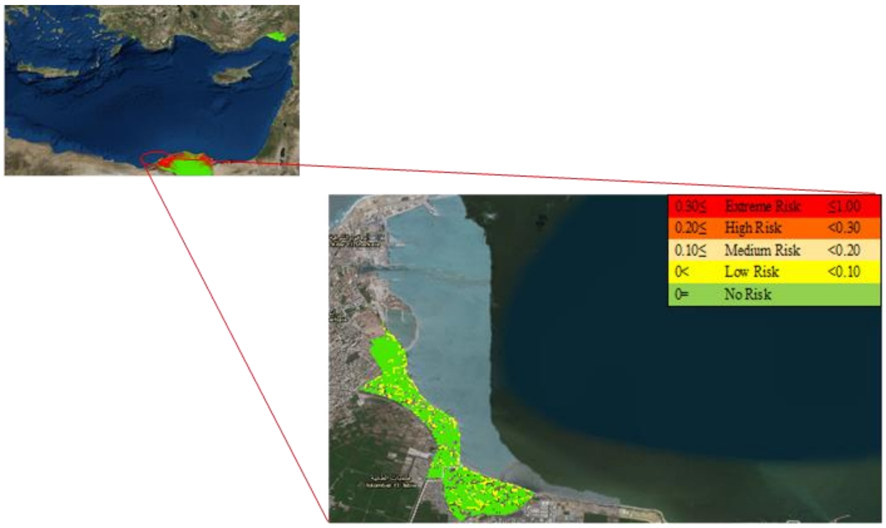

Figure D.42.2 Tsunami risk map for Abu Qir Industrial Zone

D.43 Information sheet for Abu Qir Port

Table D.43 Economic and Social Damages Values for Abu Qir Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	196
1.00	379800	10	391
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

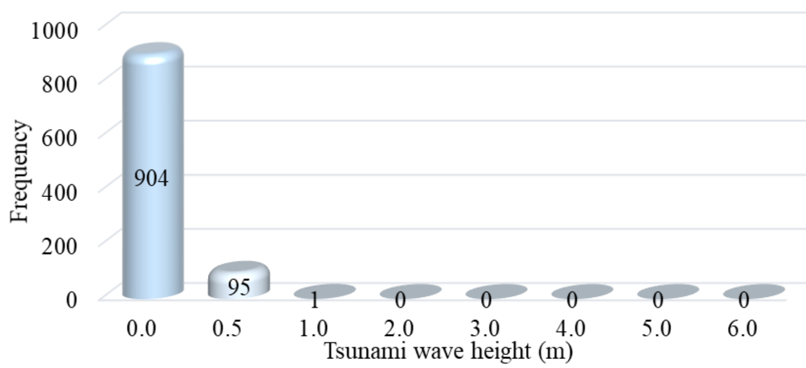

Figure D.43.1 Tsunami wave height frequency plot for Abu Qir Port

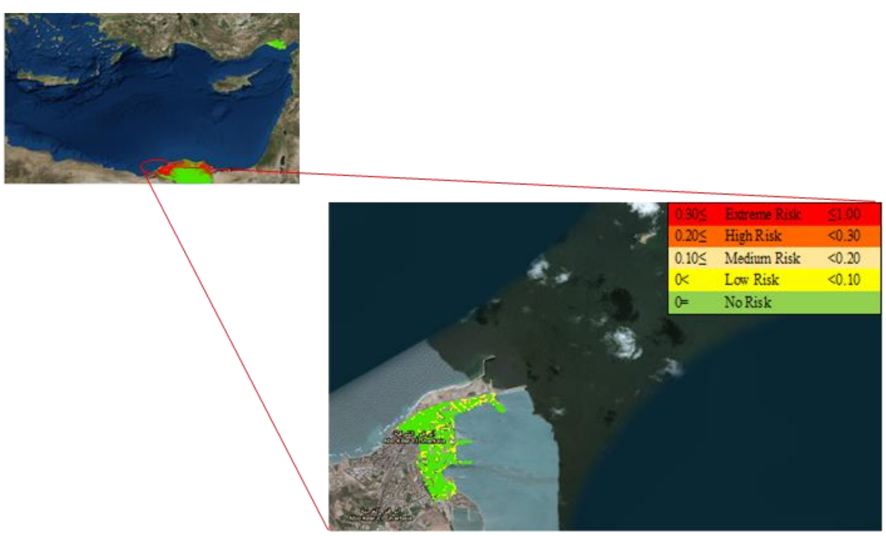

Figure D.43.2 Tsunami risk map for Abu Qir Port

D.44 Information sheet for Alexandria Airport

Table D.44 Economic and Social Damages Values for Alexandria Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	896
1.00	3086100	84	1792
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

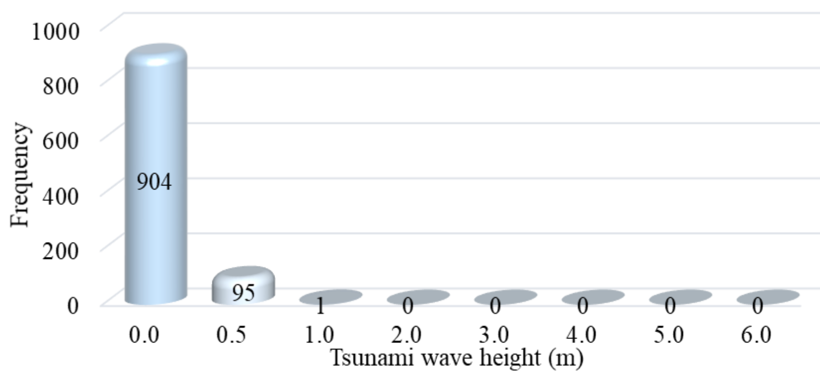

Figure D.44.1 Tsunami wave height frequency plot for Alexandria Airport

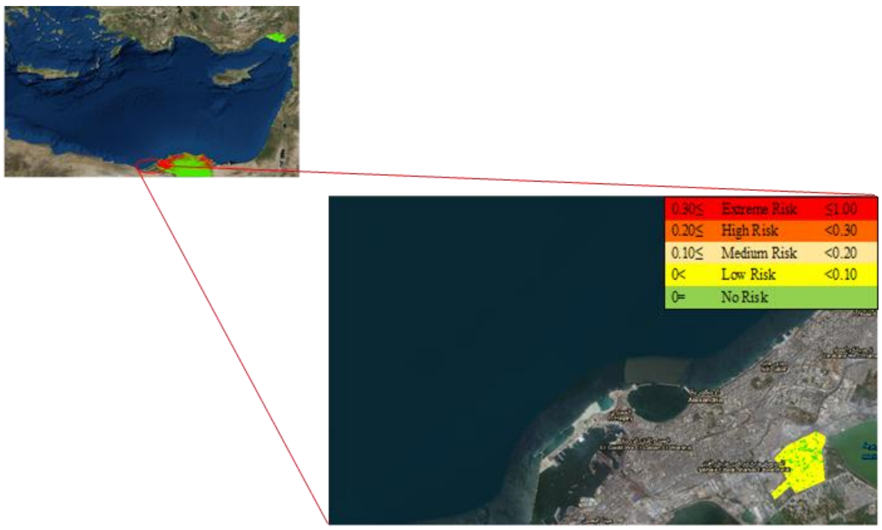

Figure D.44.2 Tsunami risk map for Alexandria Airport

D.45 Information sheet for Ashdod Port

Table D.45 Economic and Social Damages Values for Ashdod Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	43
1.00	145800	17	86
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

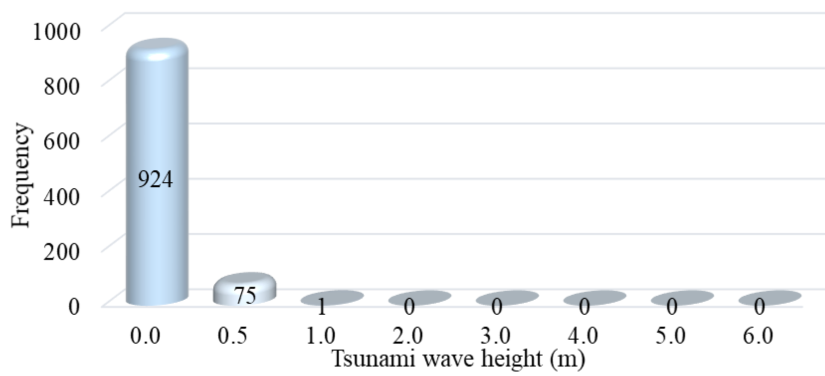

Figure D.45.1 Tsunami wave height frequency plot for Ashdod Port

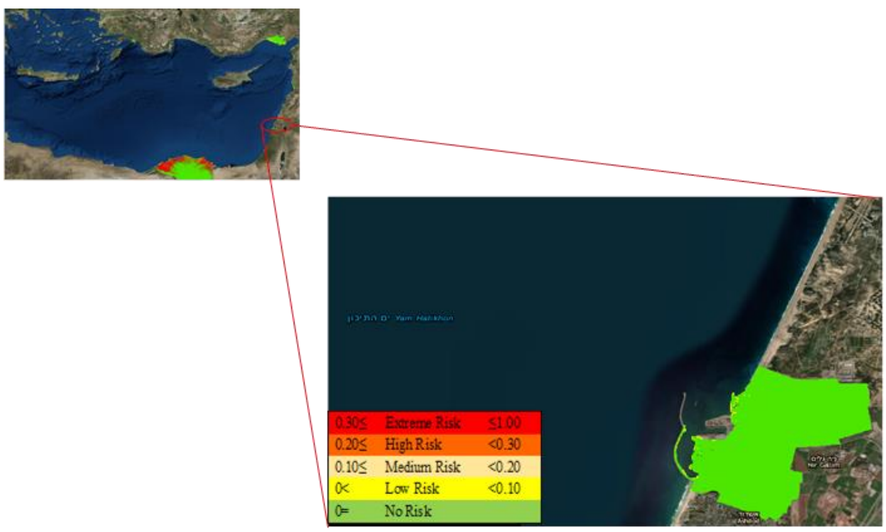

Figure D.45.2 Tsunami risk map for Ashdod Port

D.46 Information sheet for Ashkelon Seawater Desalination Plant

Table D.46 Economic and Social Damages Values for Ashkelon SDF

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	10
1.00	72000	8	20
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

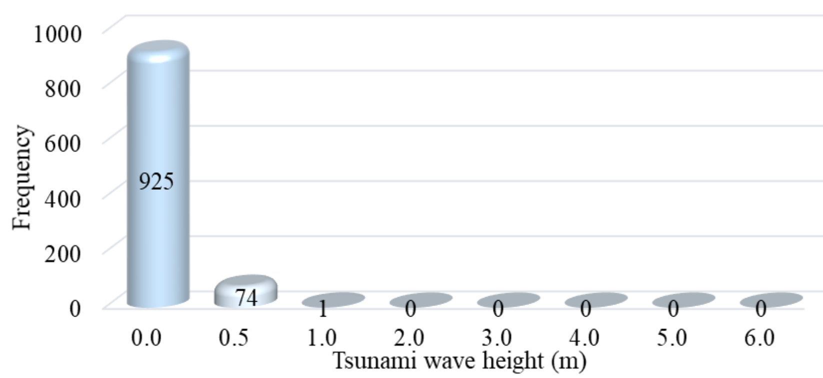

Figure D.46.1 Tsunami wave height frequency plot for Ashkelon SDF

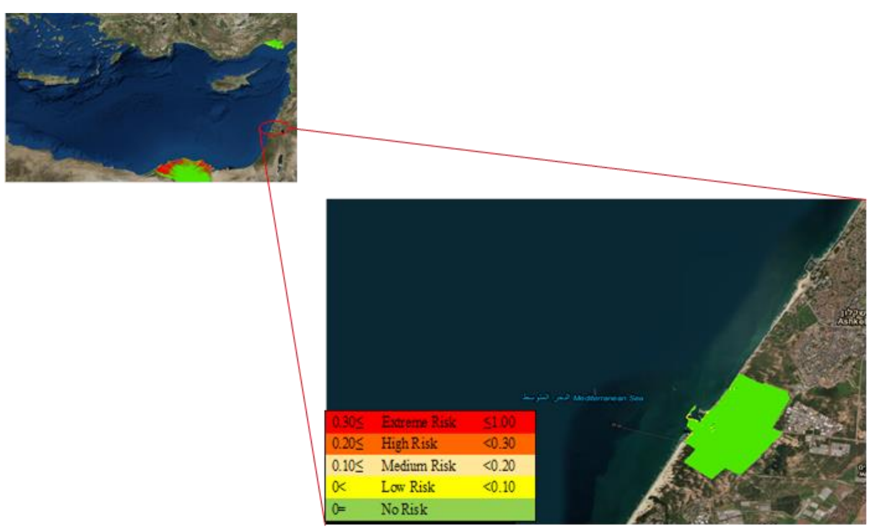

Figure D.46.2 Tsunami risk map for Ashkelon SDF

D.47 Information sheet for Beirut Airport

Table D.47 Economic and Social Damages Values for Beirut Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	531
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

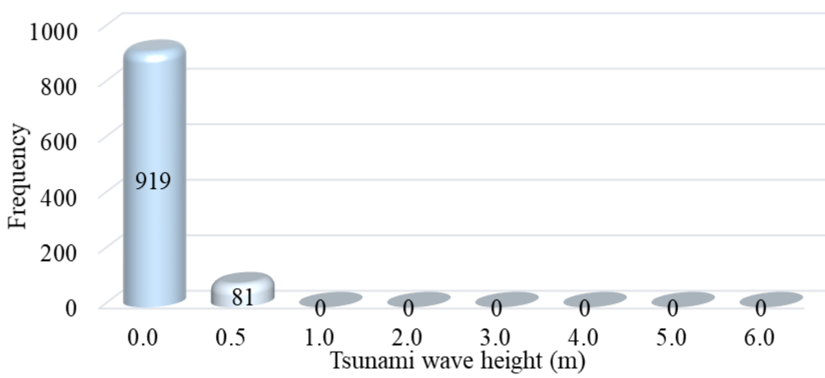

Figure D.47.1 Tsunami wave height frequency plot for Beirut Airport

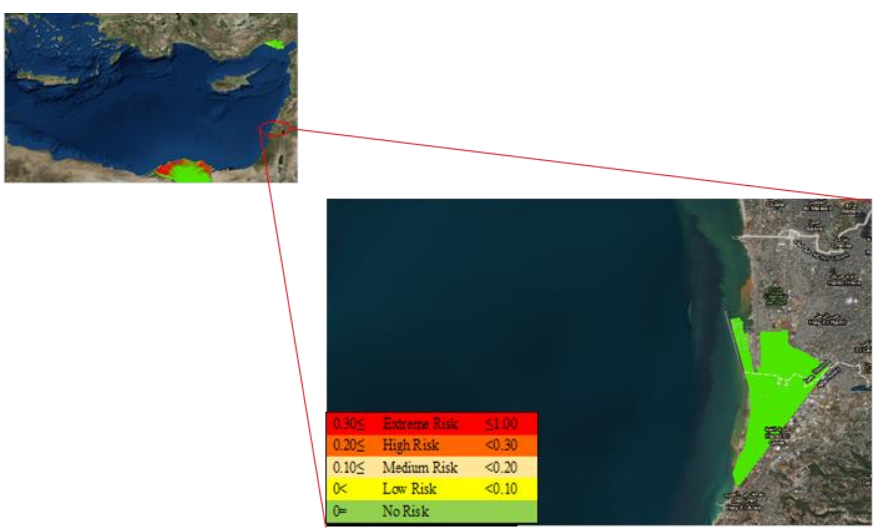

Figure D.47.2 Tsunami risk map for Beirut Airport

D.48 Information sheet for Beirut Airport

Table D.48 Economic and Social Damages Values for Beirut Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	284
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

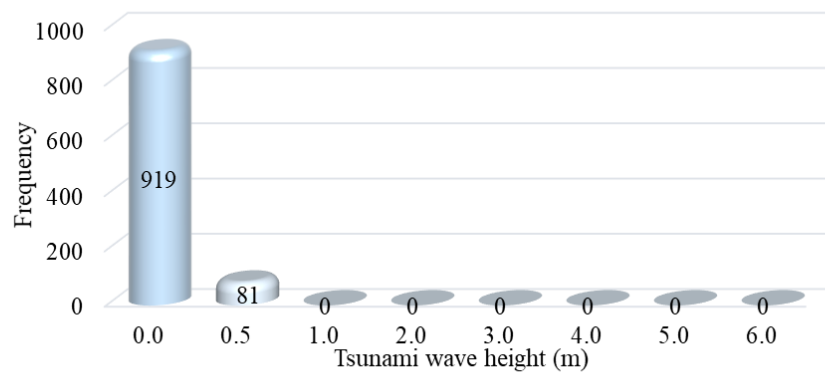

Figure D.48.1 Tsunami wave height frequency plot for Beirut Airport

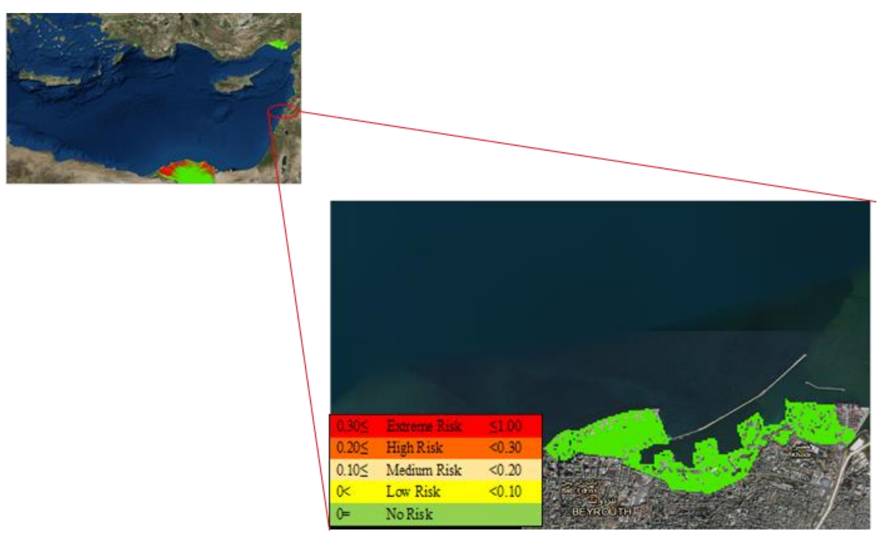

Figure D.48.2 Tsunami risk map for Beirut Airport

D.49 Information sheet for Dalaman Airport

Table D.49 Economic and Social Damages Values for Dalaman Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	627
1.00	793800	64	1254
2.00	1224900	242	3190
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

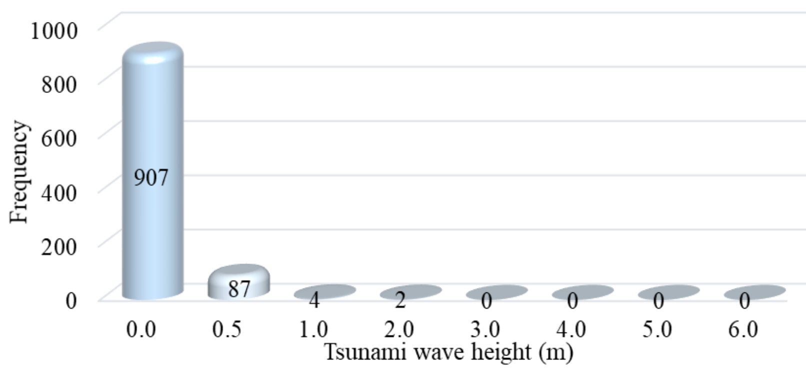

Figure D.49.1 Tsunami wave height frequency plot for Dalaman Airport

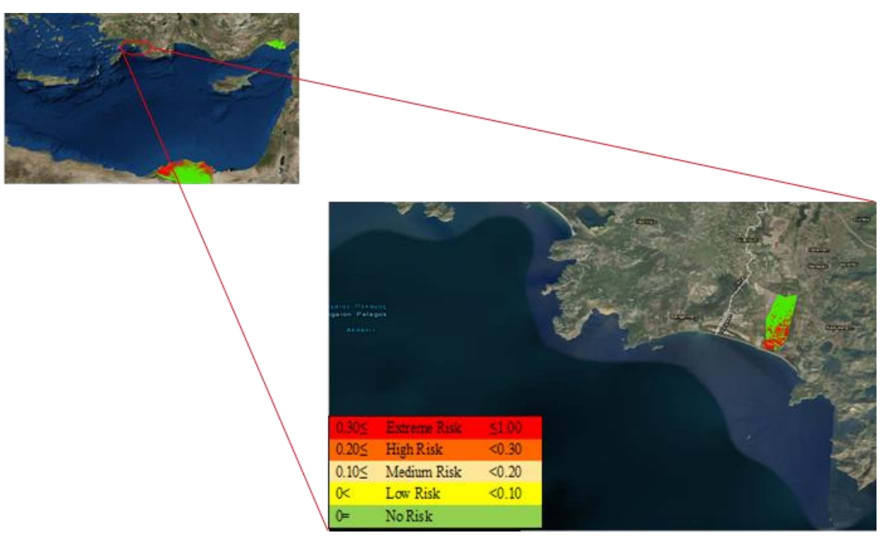

Figure D.49.2 Tsunami risk map for Dalaman Airport

D.50 Information sheet for Gazimagusa Port

Table D.50 Economic and Social Damages Values for Gazimagusa Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	3
1.00	14400	1	6
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

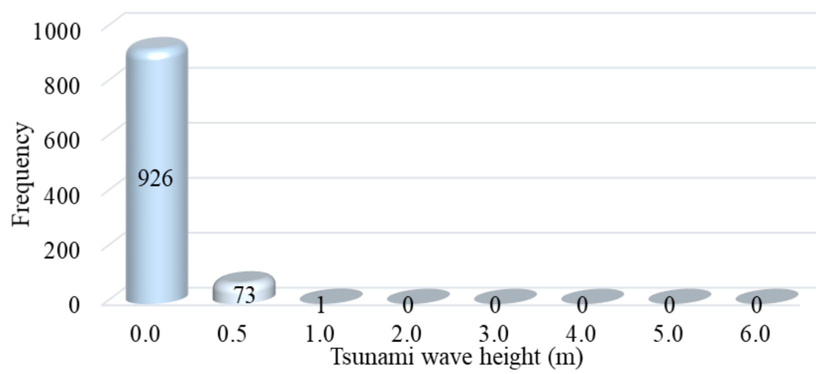

Figure D.50.1 Tsunami wave height frequency plot for Gazimagusa Port

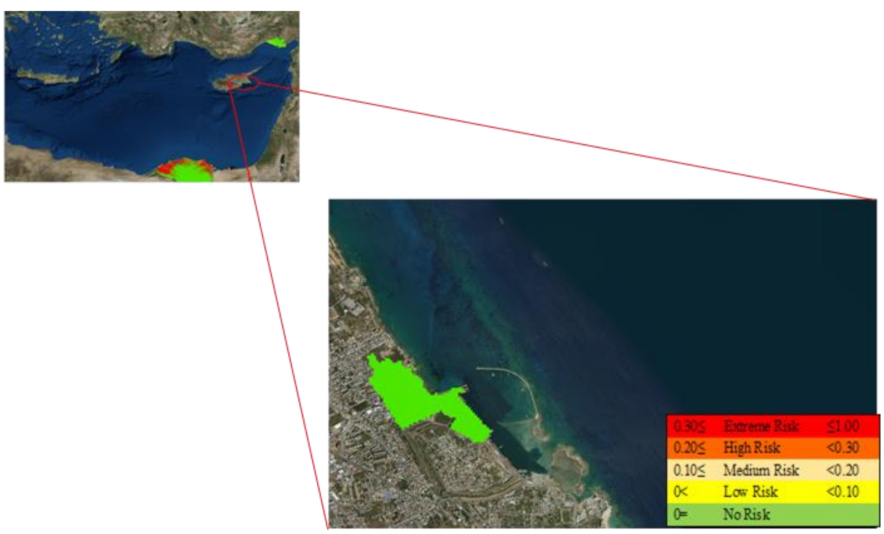

Figure D.50.2 Tsunami risk map for Gazimagusa Port

D.51 Information sheet for Haifa Airport

Table D.51 Economic and Social Damages Values for Haifa Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	9
1.00	48600	6	19
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

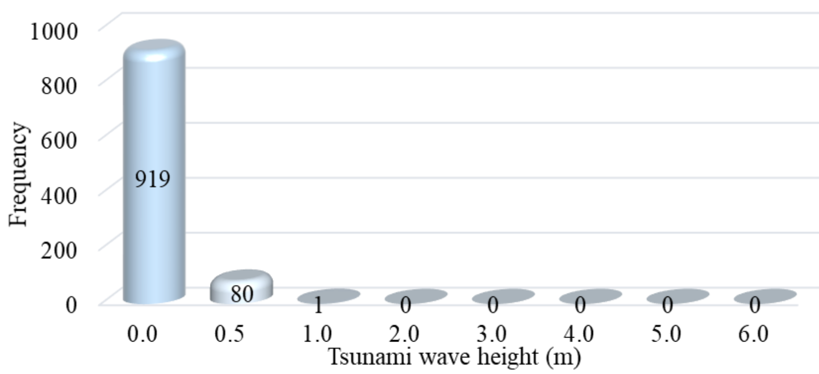

Figure D.51.1 Tsunami wave height frequency plot for Haifa Airport

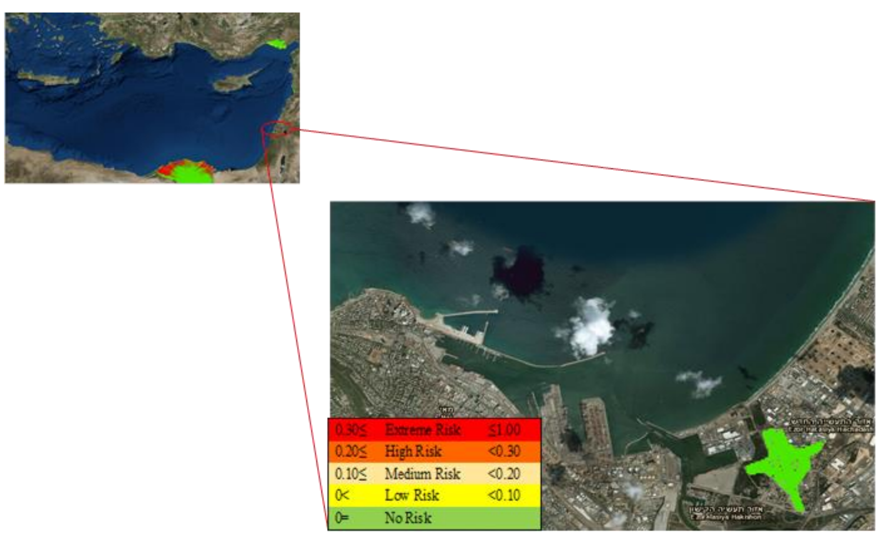

Figure D.51.2 Tsunami risk map for Haifa Airport

D.52 Information sheet for Haifa Port and Industrial Zone

Table D.52 Economic and Social Damages Values for Haifa Port and Industrial Zone

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	123
1.00	942300	90	246
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

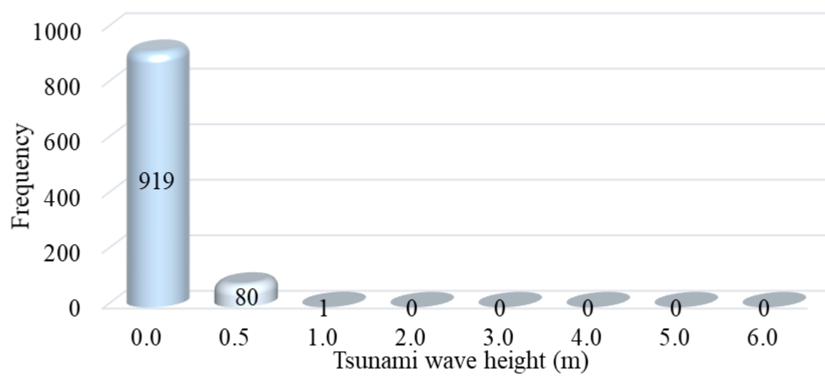

Figure D.52.1 Tsunami wave height frequency plot for Haifa Port and Industrial Zone

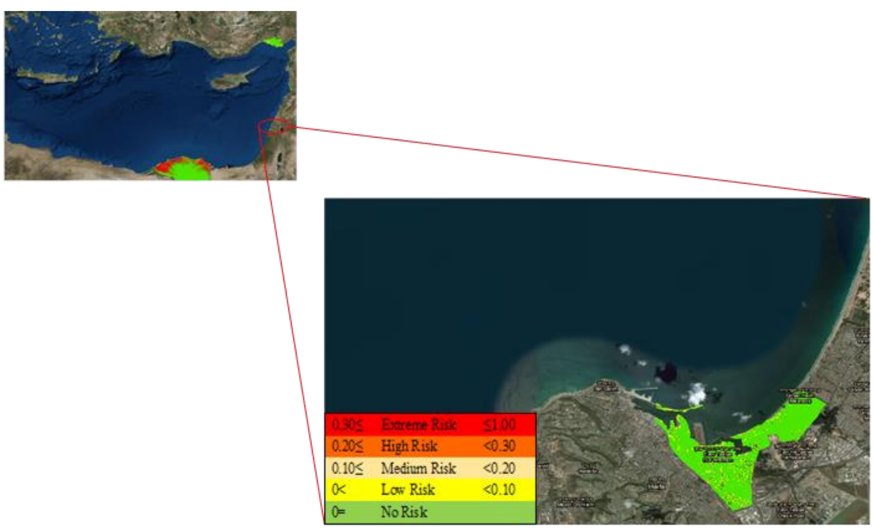

Figure D.52.2 Tsunami risk map for Haifa Port and Industrial Zone

D.53 Information sheet for Heraklion Airport

Table D.53 Economic and Social Damages Values for Heraklion Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	0
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

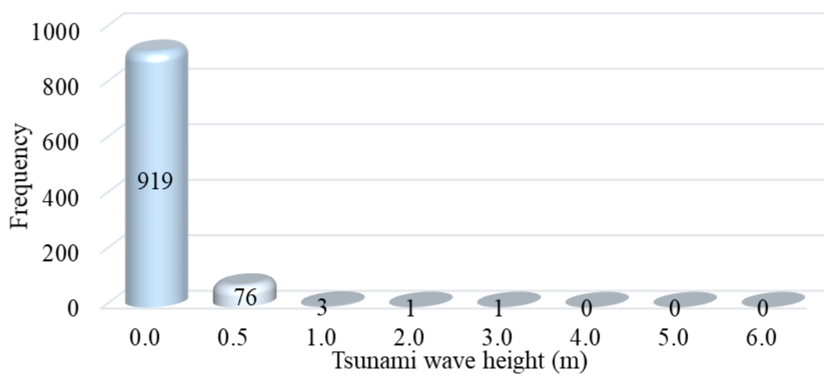

Figure D.53.1 Tsunami wave height frequency plot for Heraklion Airport

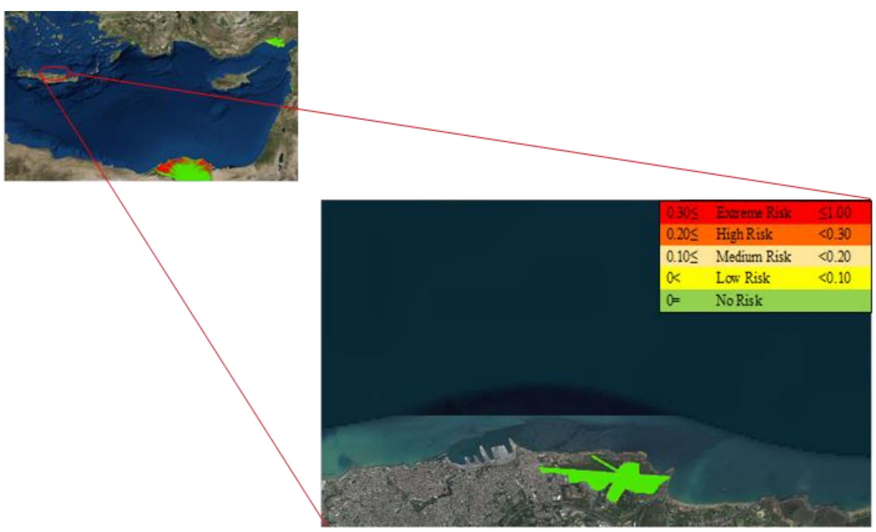

Figure D.53.2 Tsunami risk map for Heraklion Airport

D.54 Information sheet for Herzliya Marina

Table D.54 Economic and Social Damages Values for Herzliya Marina

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	85
1.00	64800	7	169
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

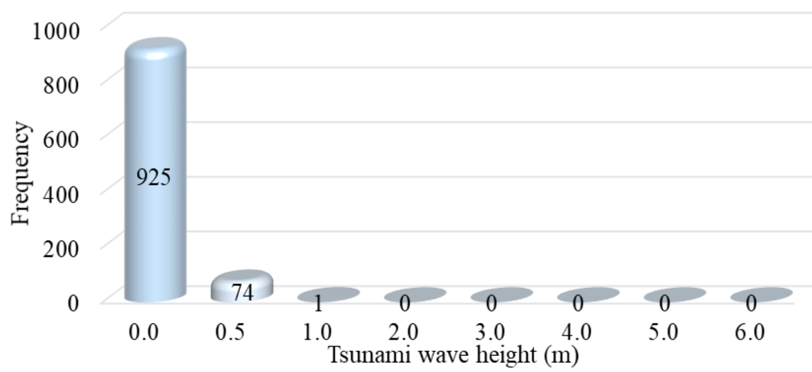

Figure D.54.1 Tsunami wave height frequency plot for Herzliya Marina

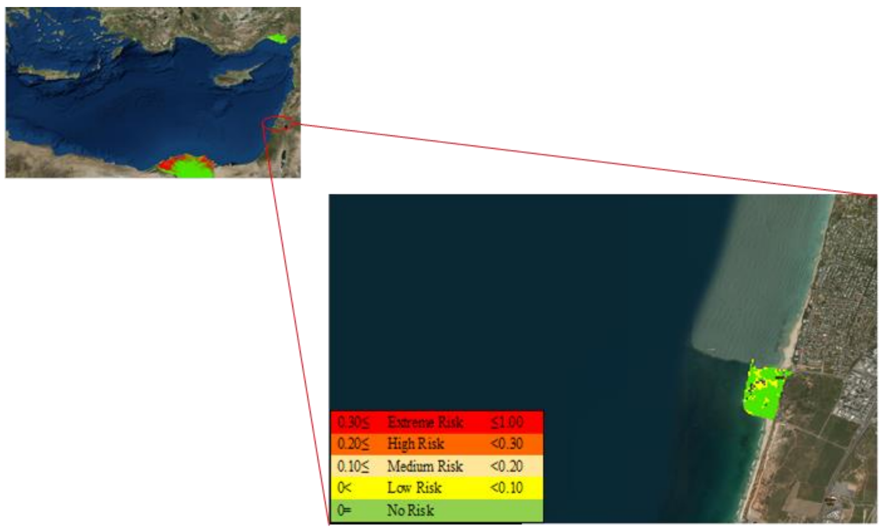

Figure D.54.2 Tsunami risk map for Herzliya Marina

D.55 Information sheet for Iskenderun Iron and Steel Port

Table D.55 Economic and Social Damages Values for Iskenderun Iron and Steel Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	65
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

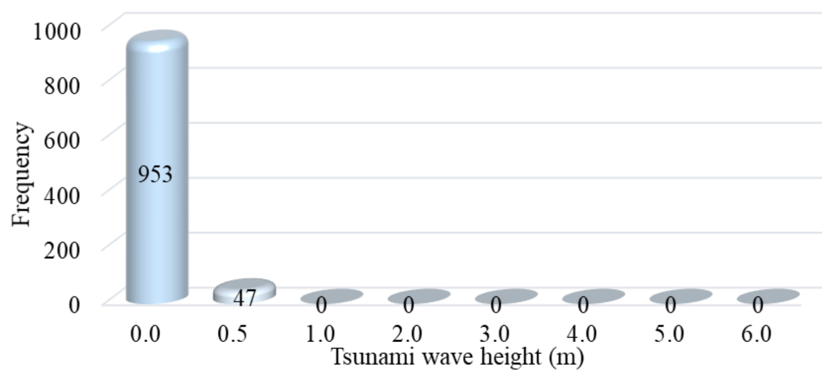

Figure D.55.1 Tsunami wave height frequency plot for Iskenderun Iron and Steel Port

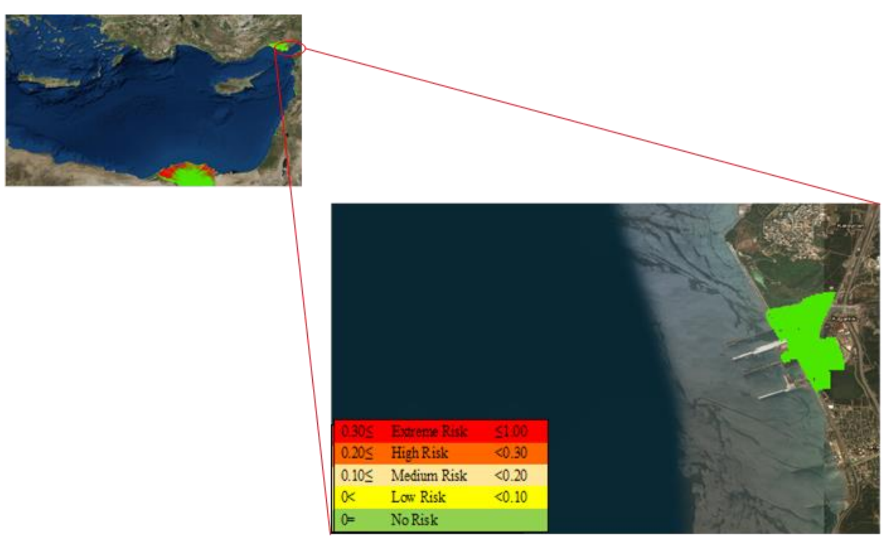

Figure D.55.2 Tsunami risk map for Iskenderun Iron and Steel Port

D.56 Information sheet for Iskenderun Port

Table D.56 Economic and Social Damages Values for Iskenderun Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	11
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

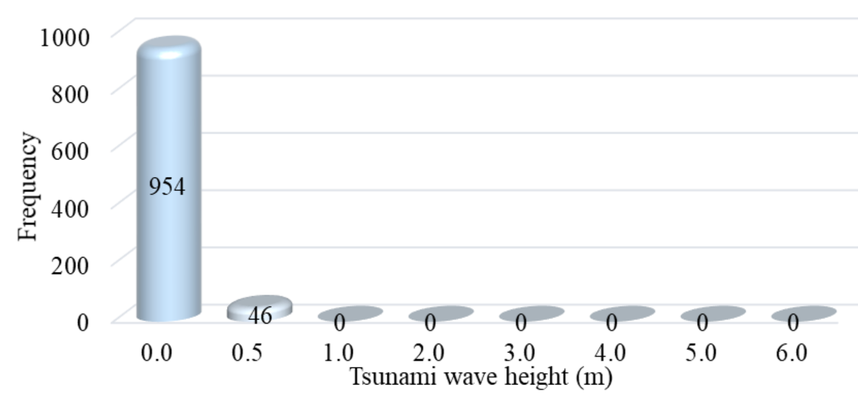

Figure D.56.1 Tsunami wave height frequency plot for Iskenderun Port

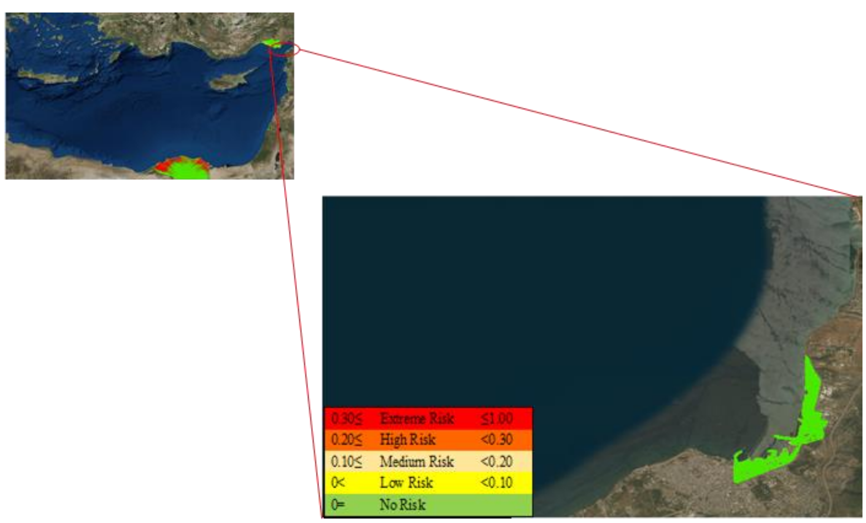

Figure D.56.2 Tsunami risk map for Iskenderun Port

D.57 Information sheet for Koubba Industrial Zone

Table D.57 Economic and Social Damages Values for Koubba Industrial Zone

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	12
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

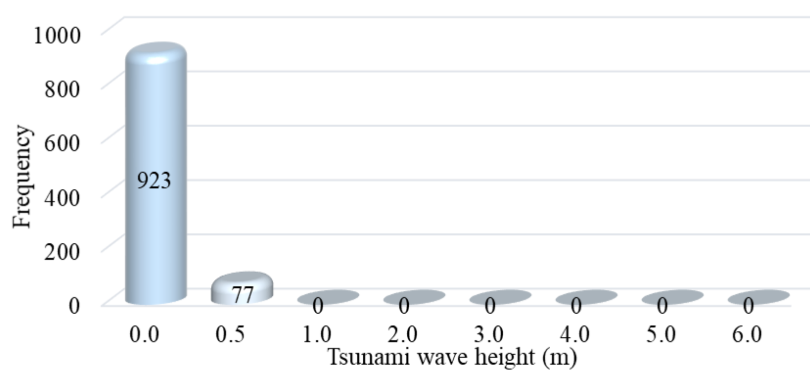

Figure D.57.1 Tsunami wave height frequency plot for Koubba Industrial Zone

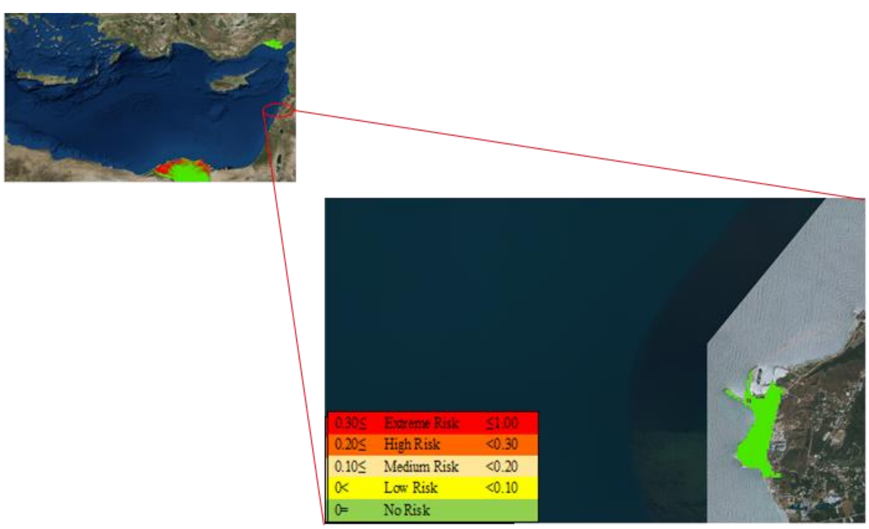

Figure D.57.2 Tsunami risk map for Koubba Industrial Zone

D.58 Information sheet for Larnaca Airport

Table D.58 Economic and Social Damages Values for Larnaca Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	2050
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

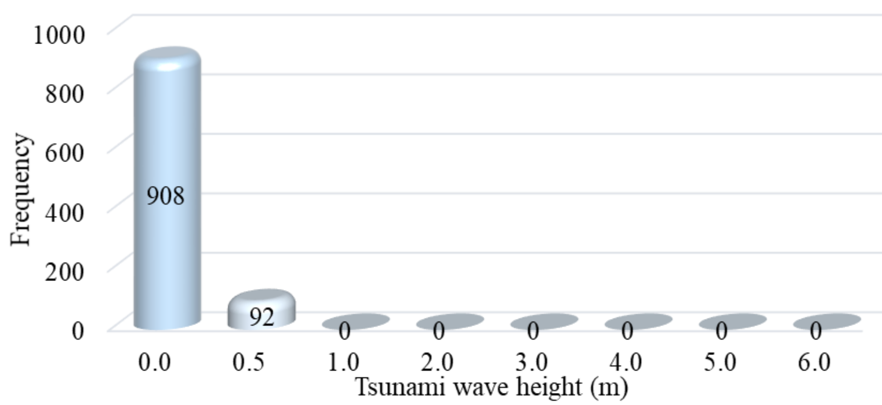

Figure D.58.1 Tsunami wave height frequency plot for Larnaca Airport

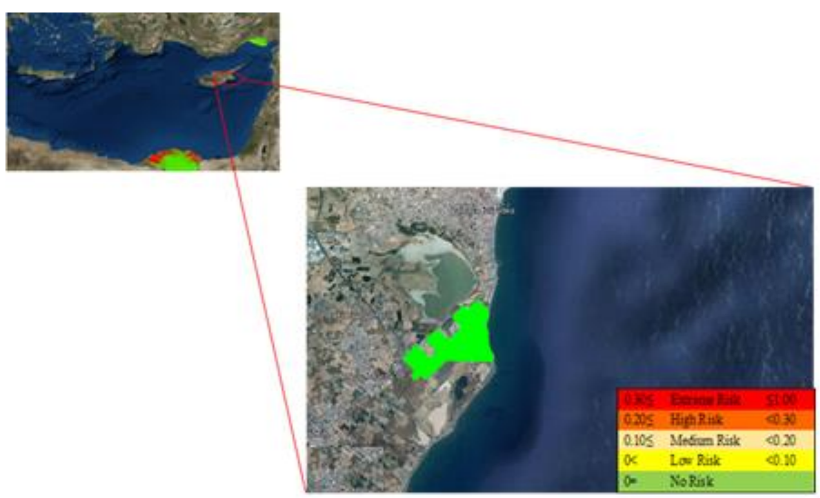

Figure D.58.2 Tsunami risk map for Larnaca Airport

D.59 Information sheet for Latakia Port

Table D.59 Economic and Social Damages Values for Latakia Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	45
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

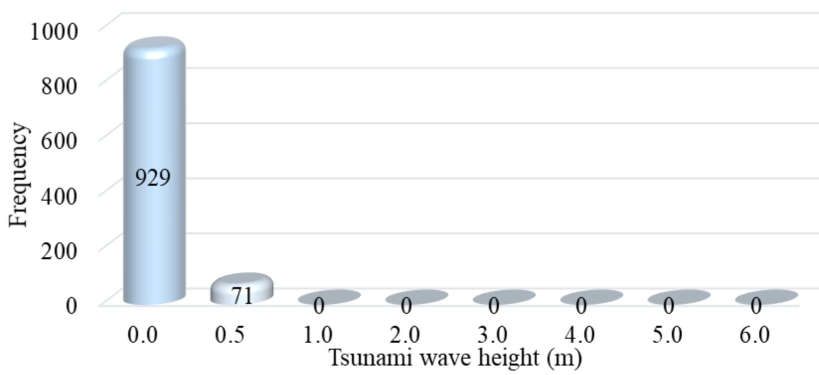

Figure D.59.1 Tsunami wave height frequency plot for Latakia Port

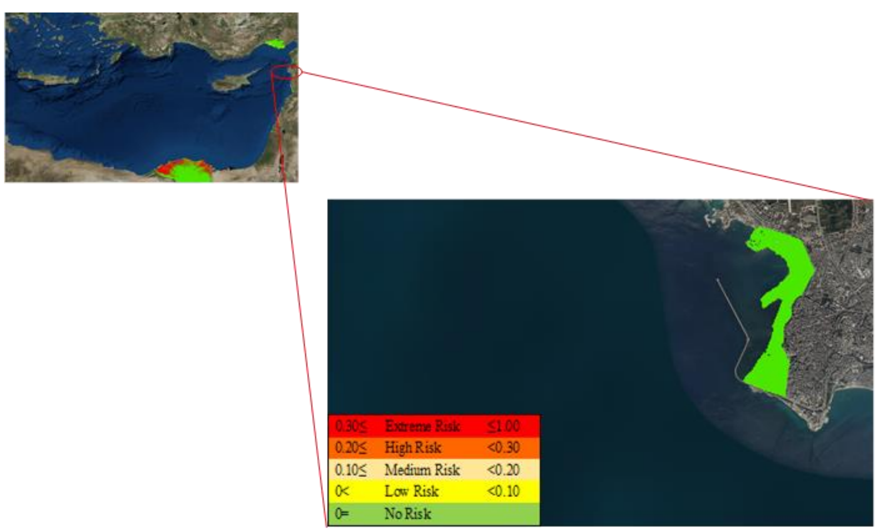

Figure D.59.2 Tsunami risk map for Latakia Port

D.60 Information sheet for Marina Dbayeh

Table D.60 Economic and Social Damages Values for Marina Dbayeh

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	453
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

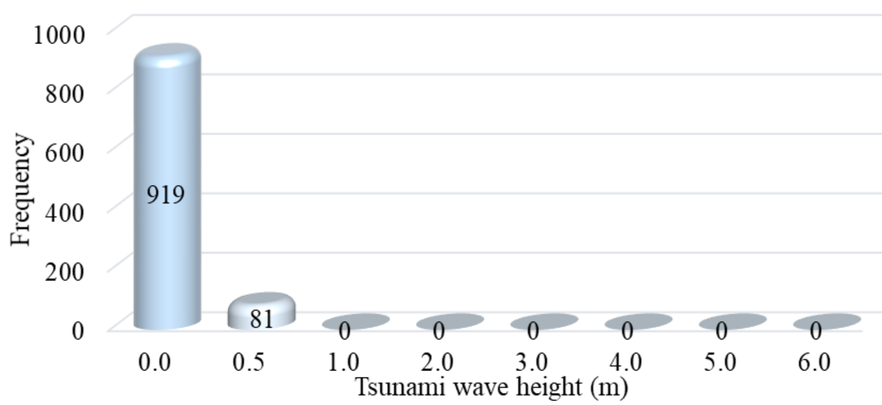

Figure D.60.1 Tsunami wave height frequency plot for Marina Dbayeh

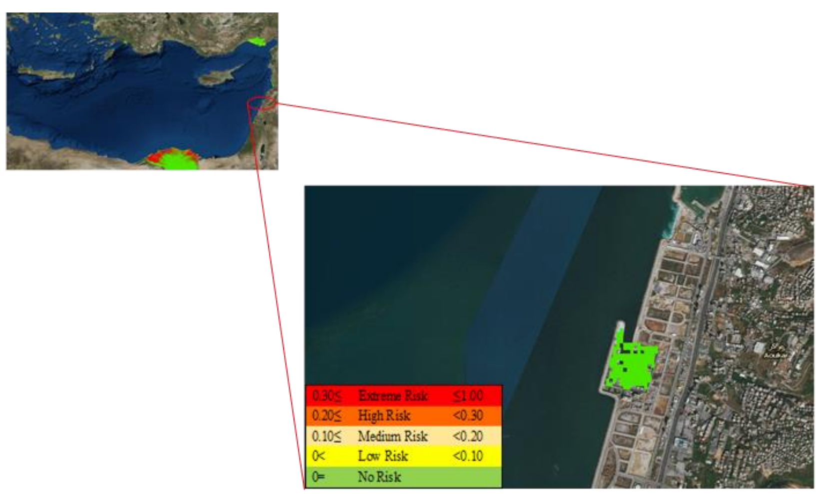

Figure D.60.2 Tsunami risk map for Marina Dbayeh

D.61 Information sheet for Mersin Port

Table D.61 Economic and Social Damages Values for Mersin Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	36
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

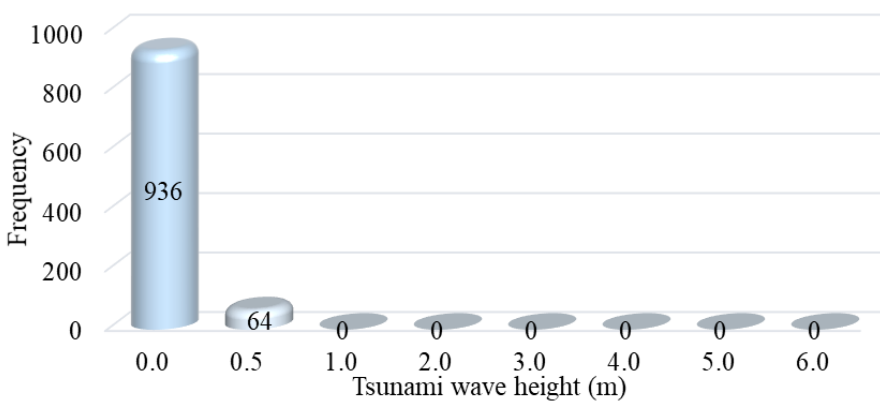

Figure D.61.1 Tsunami wave height frequency plot for Mersin Port

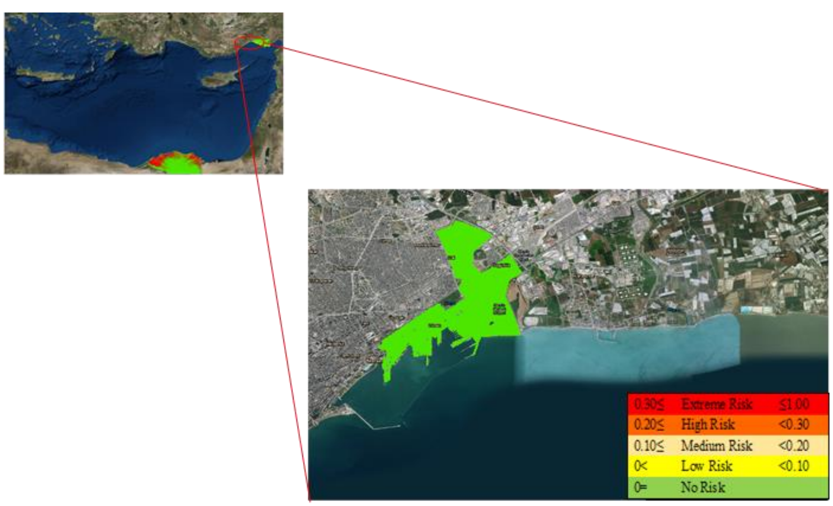

Figure D.61.2 Tsunami risk map for Mersin Port

D.62 Information sheet for MMK Metallurgy Port

Table D.62 Economic and Social Damages Values for MMK Metallurgy Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	4
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

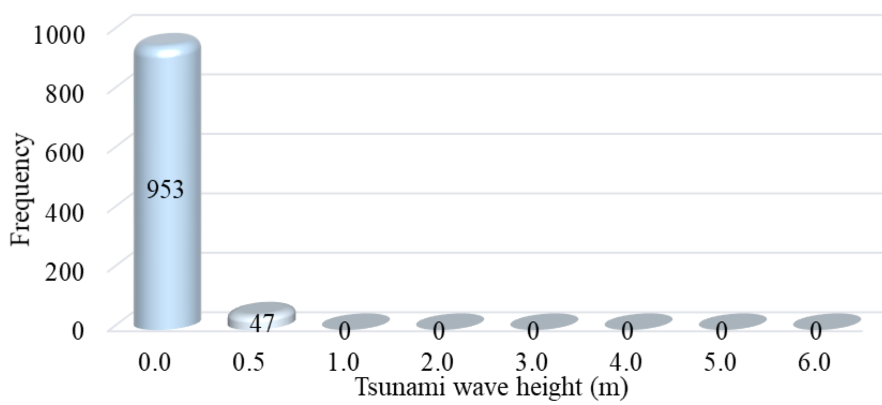

Figure D.62.1 Tsunami wave height frequency plot for MMK Metallurgy Port

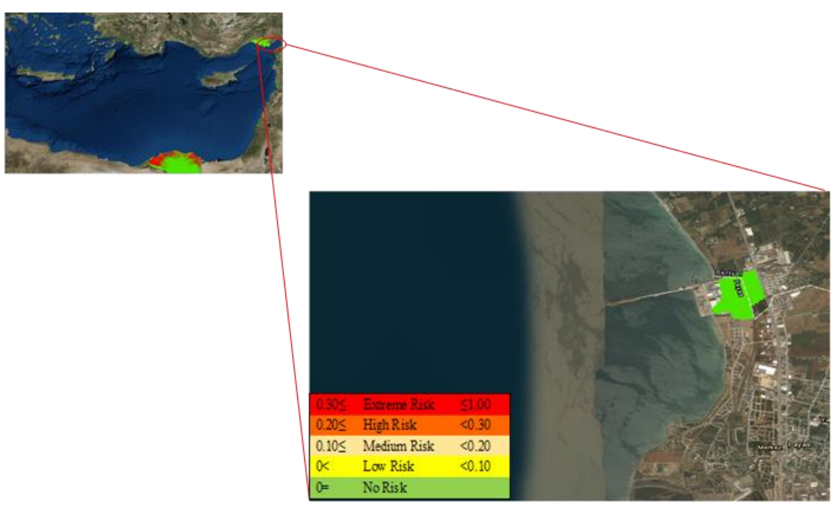

Figure D.62.2 Tsunami risk map for MMK Metallurgy Port

D.63 Information sheet for Palmachi Airbase

Table D.63 Economic and Social Damages Values for Palmachi Airbase

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	
1.00	17100	2	
2.00	0	0	
3.00	0	0	No information
4.00	0	0	
5.00	0	0	
6.00	0	0	

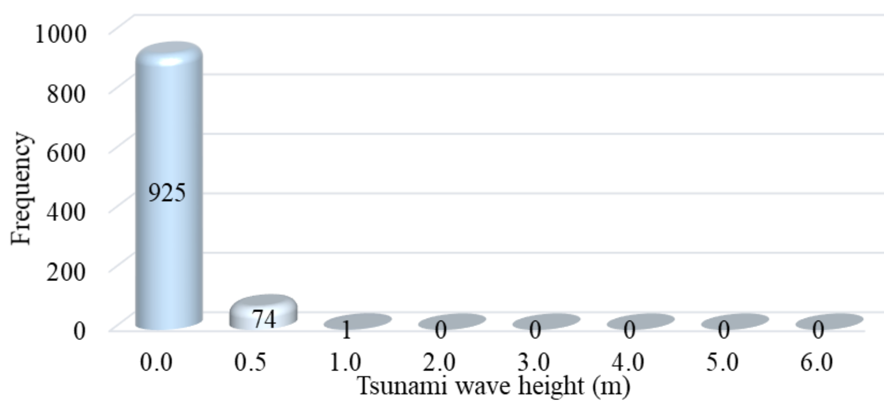

Figure D.63.1 Tsunami wave height frequency plot for Palmachi Airbase

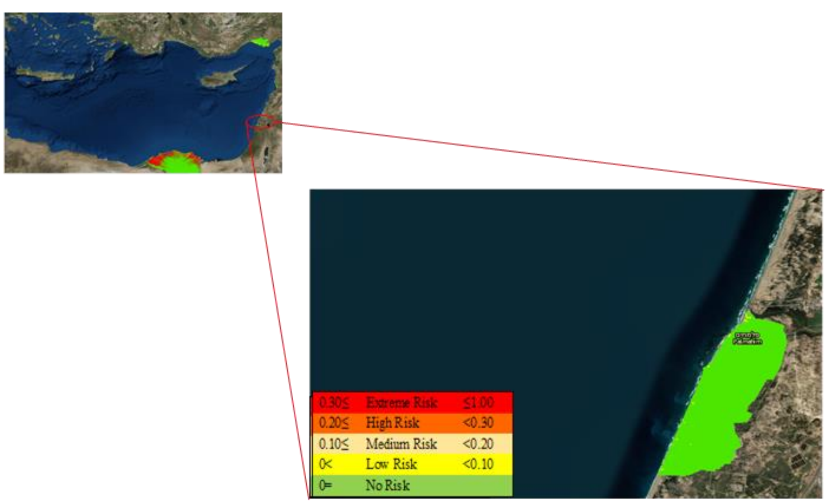

Figure D.63.2 Tsunami risk map for Palmachi Airbase

D.64 Information sheet for Paphos International Airport

Table D.64 Economic and Social Damages Values for Paphos International Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	17
1.00	2700	0.3	33
2.00	13500	2	199
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

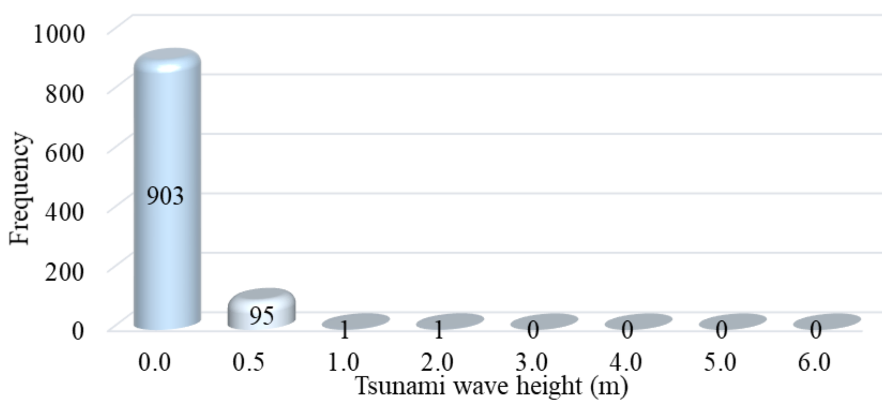

Figure D.64.1 Tsunami wave height frequency plot for Paphos International Airport

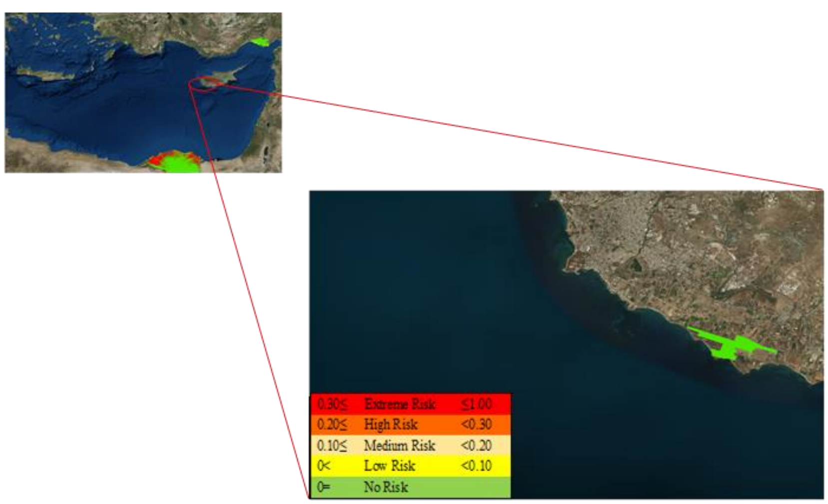

Figure D.64.2 Tsunami risk map for Paphos International Airport

D.65 Information sheet for Port Akdeniz

Table D.65 Economic and Social Damages Values for Port Akdeniz

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1423
1.00	237600	19	2846
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

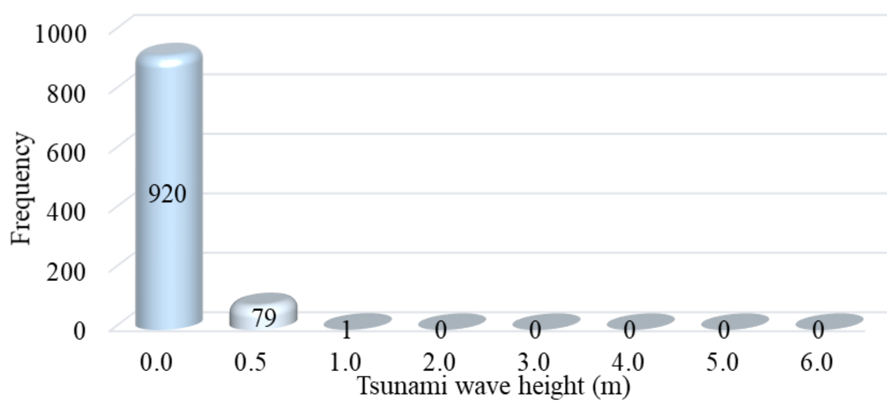

Figure D.65.1 Tsunami wave height frequency plot for Port Akdeniz

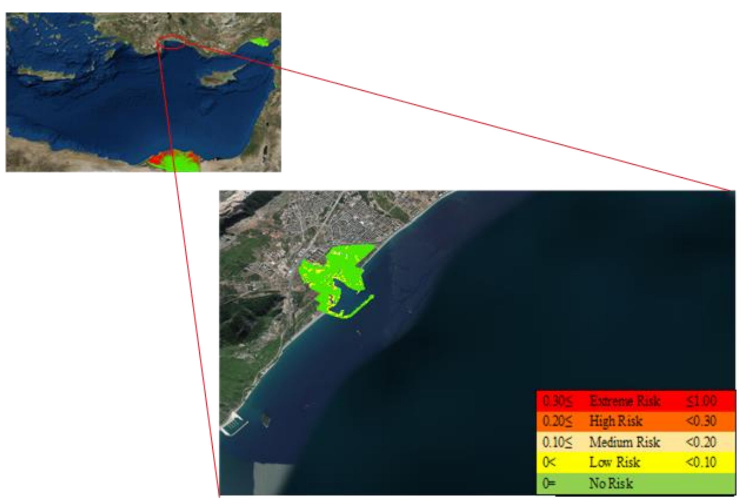

Figure D.65.2 Tsunami risk map for Port Akdeniz

D.66 Information sheet for Port Said Airport

Table D.66 Economic and Social Damages Values for Port Said Airport

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	11
1.00	237600	6	23
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

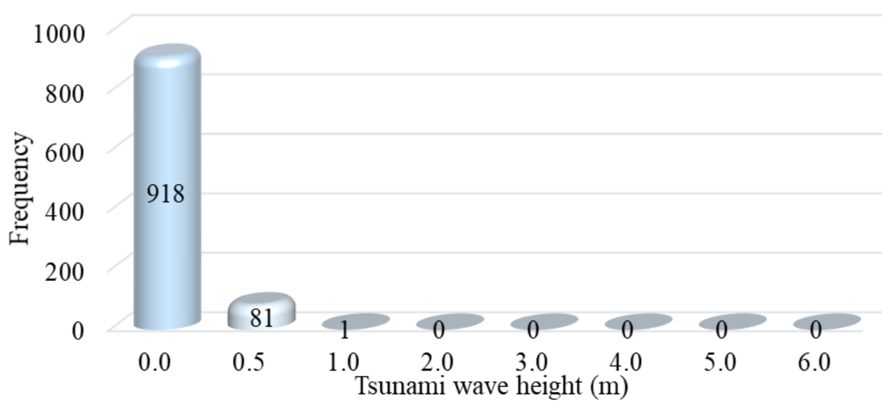

Figure D.66.1 Tsunami wave height frequency plot for Port Said Airport

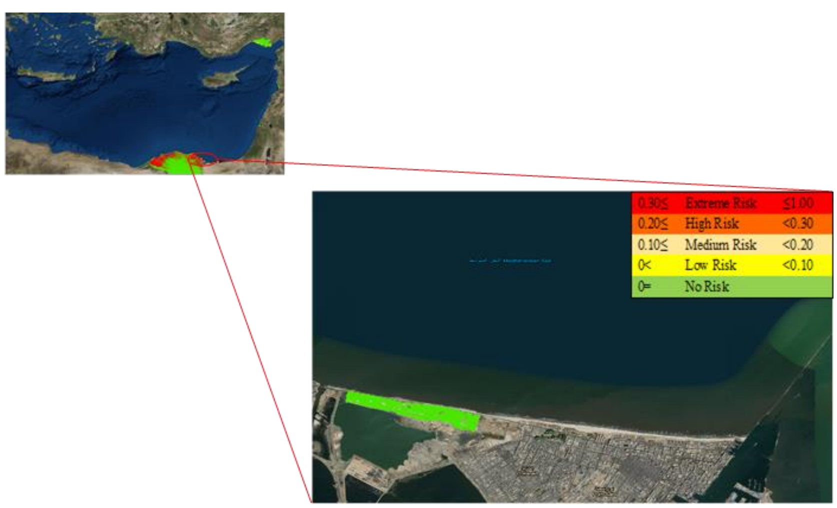

Figure D.66.2 Tsunami risk map for Port Said Airport

D.67 Information sheet for Port Said Port

Table D.67 Economic and Social Damages Values for Port Said Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	200
1.00	408600	11	400
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

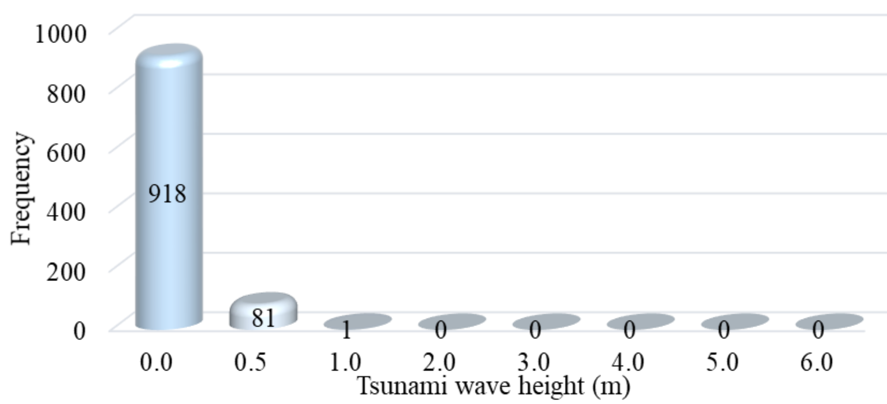

Figure D.67.1 Tsunami wave height frequency plot for Port Said Port

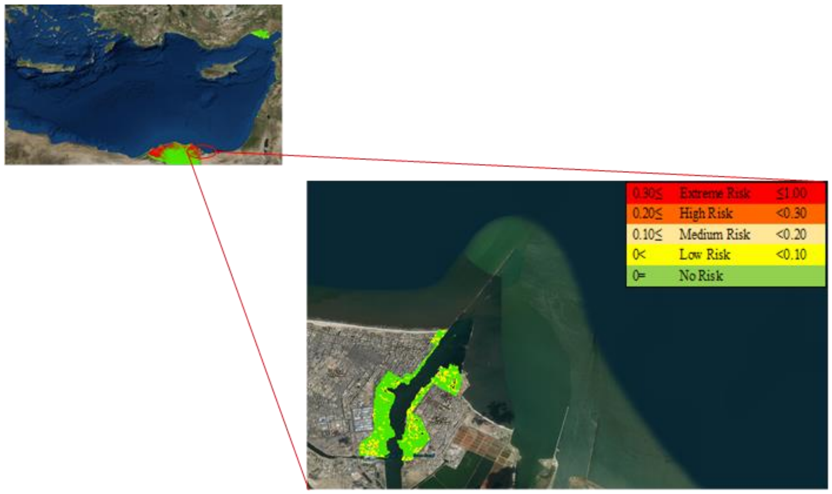

Figure D.67.2 Tsunami risk map for Port Said Port

D.68 Information sheet for Tartus Port

Table D.68 Economic and Social Damages Values for Tartus Port

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	157
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

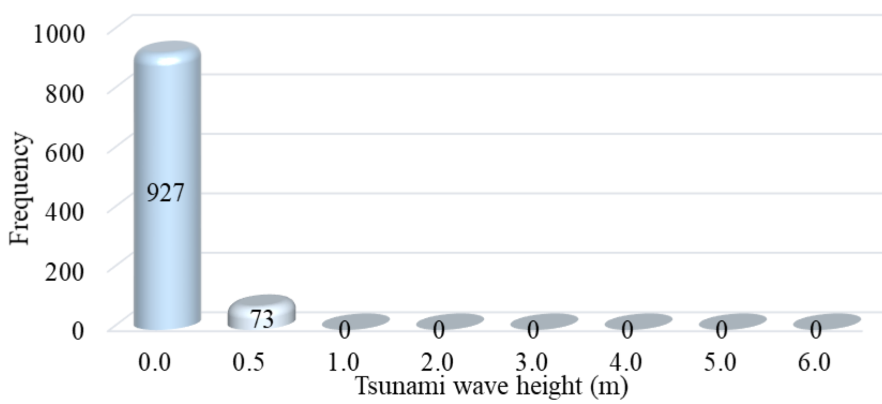

Figure D.68.1 Tsunami wave height frequency plot for Tartus Port

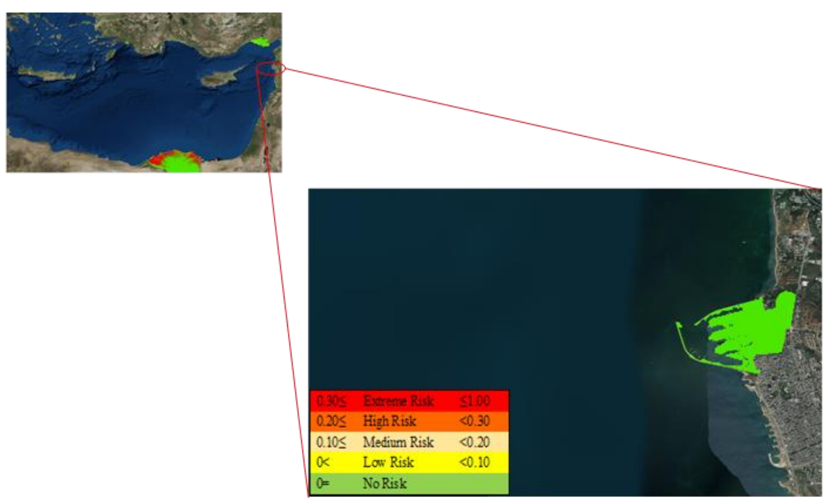

Figure D.68.2 Tsunami risk map for Tartus Port

D.69 Information sheet for Tirtar Yatch Marina

Table D.69 Economic and Social Damages Values for Tirtar Yatch Marina

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	0
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

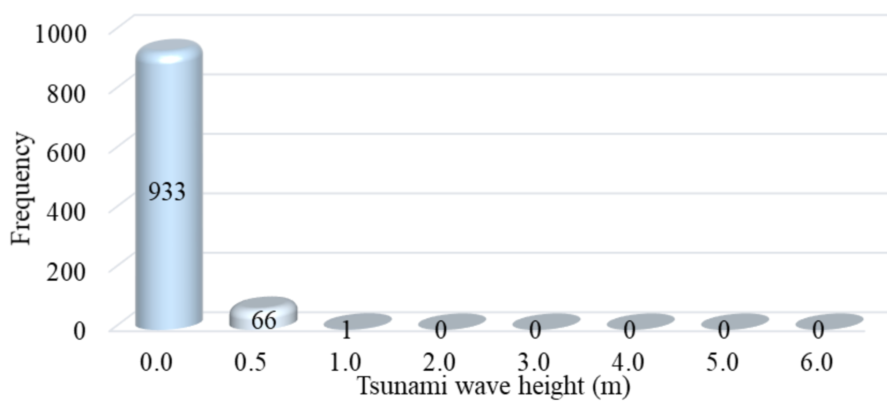

Figure D.69.1 Tsunami wave height frequency plot for Tirtar Yatch Marina

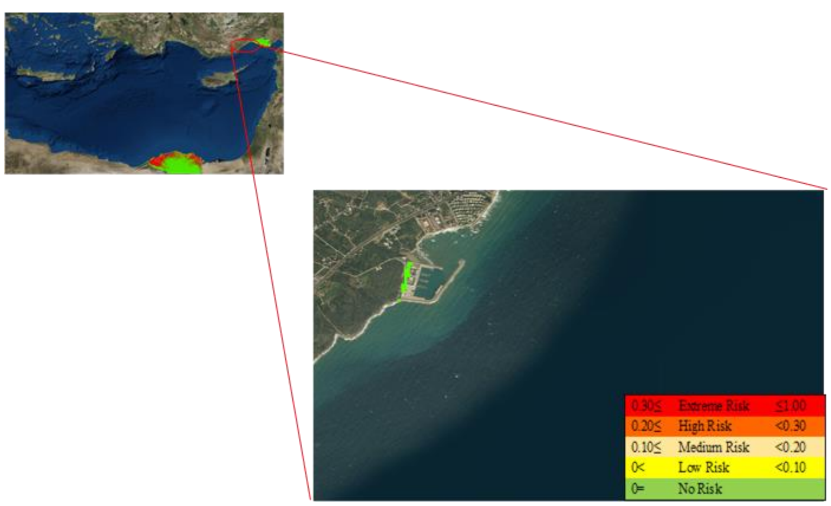

Figure D.69.2 Tsunami risk map for Tirtar Yatch Marina

D.70 Information sheet for Tripoli Port

Table D.70 Economic and Social Damages Values for Tripoli Port

Inundation level (m)	Affected area (m²)	Economic damage (1*10⁶€)	Social damage (NP)
0.50	-	-	89
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

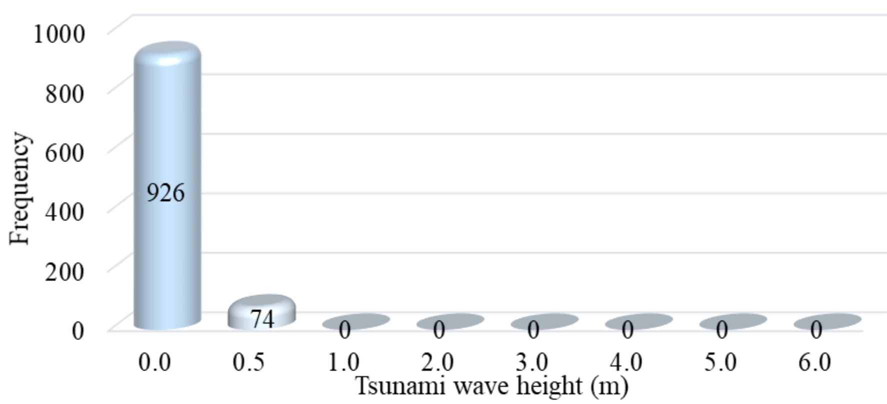

Figure D.70.1 Tsunami wave height frequency plot for Tripoli Port

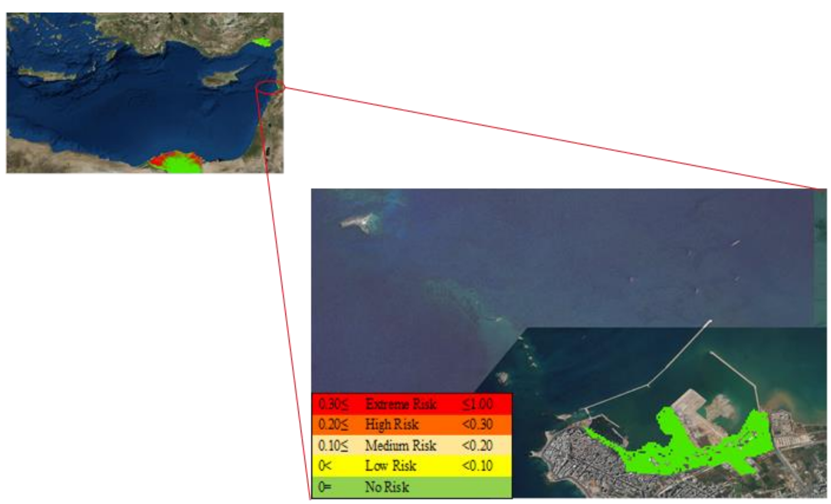

Figure D.70.2 Tsunami risk map for Tripoli Port

D.71 Information sheet for Cairo Agricultural Area

Table D.71 Economic and Social Damages Values for Cairo Agricultural Area

Inundation level (m)	Affected area (ha)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1165408
1.00	564343	1618	2330815
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

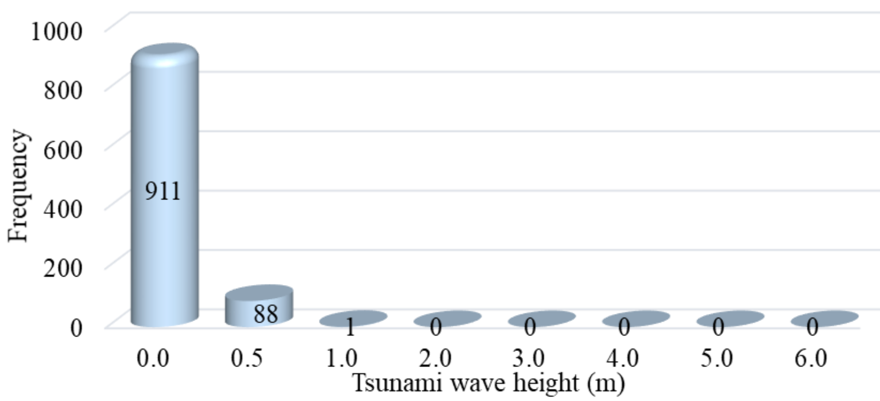

Figure D.71.1 Tsunami wave height frequency plot for Cairo Agricultural Area

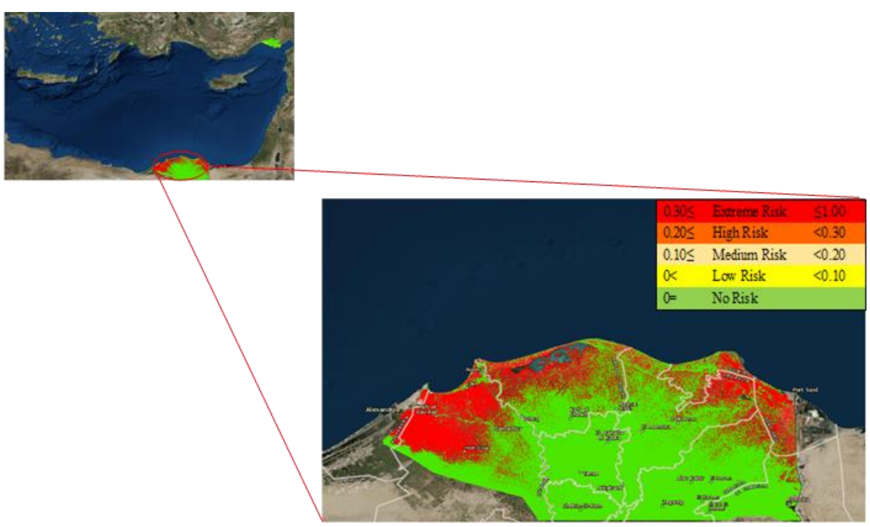

Figure D.71.2 Tsunami risk map for Cairo Agricultural Area

D.72 Information sheet for Cukurova Agricultural Area

Table D.72 Economic and Social Damages Values for Cukurova Agricultural Area

Inundation level (m)	Affected area (ha)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	8593
1.00	26038	11	17185
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

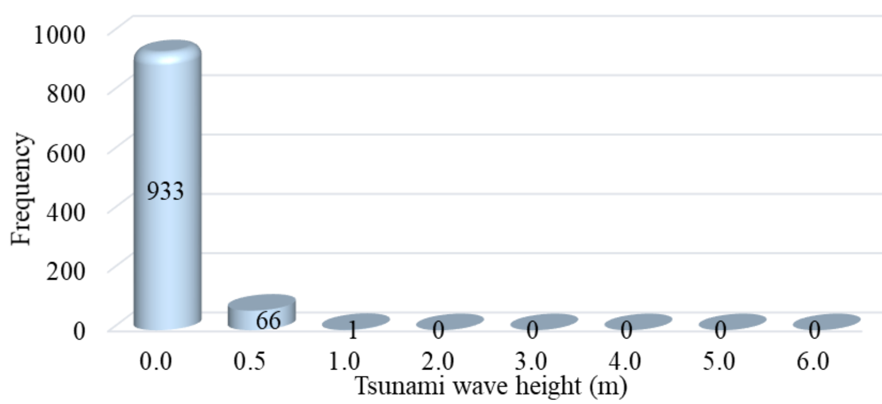

Figure D.72.1 Tsunami wave height frequency plot for Cukurova Agricultural Area

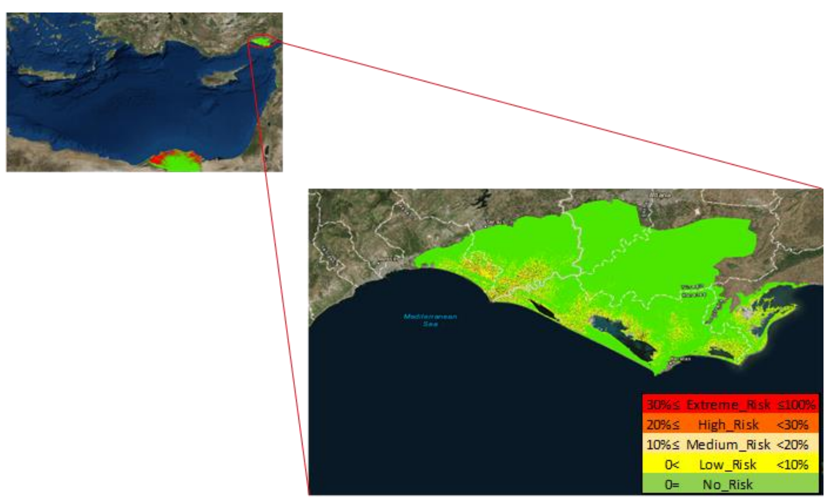

Figure D.72.2 Tsunami risk map for Cukurova Agricultural Area

D.73 Information sheet for Dalaman Agricultural Area

Table D.73 Economic and Social Damages Values for Dalaman Agricultural Area

Inundation level (m)	Affected area (ha)	Economic damage (1*10^6€)	Social damage (NP)
0.50	-	-	657
1.00	165	0.1	1313
2.00	393	0.4	4434
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

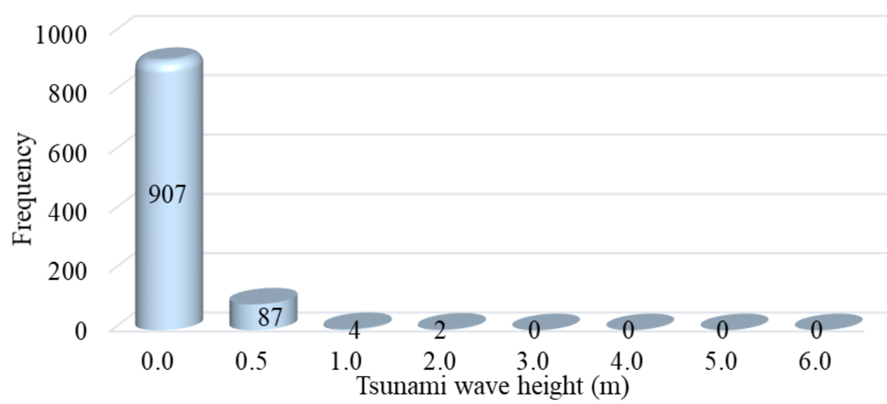

Figure D.73.1 Tsunami wave height frequency plot for Dalaman Agricultural Area

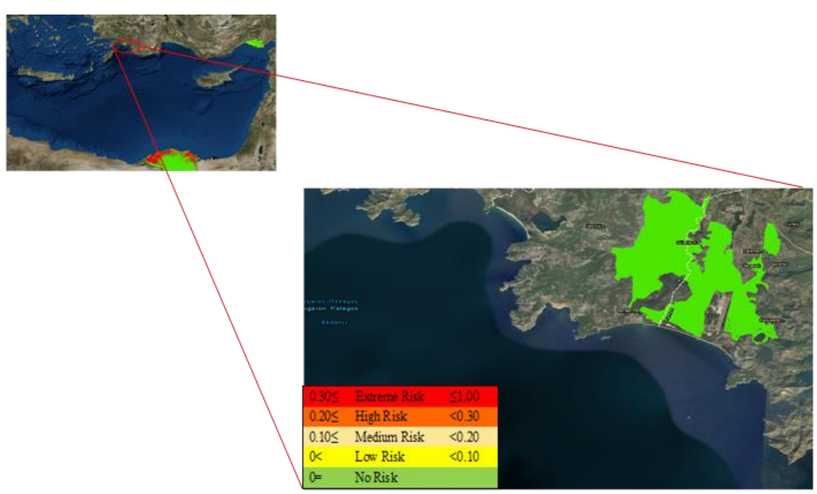

Figure D.73.2 Tsunami risk map for Dalaman Agricultural Area

D.74 Information sheet for Samandag Agricultural Area

Table D.74 Economic and Social Damages Values for Samandag Agricultural Area

Inundation level (m)	Affected area (ha)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	118
1.00	89	0	237
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

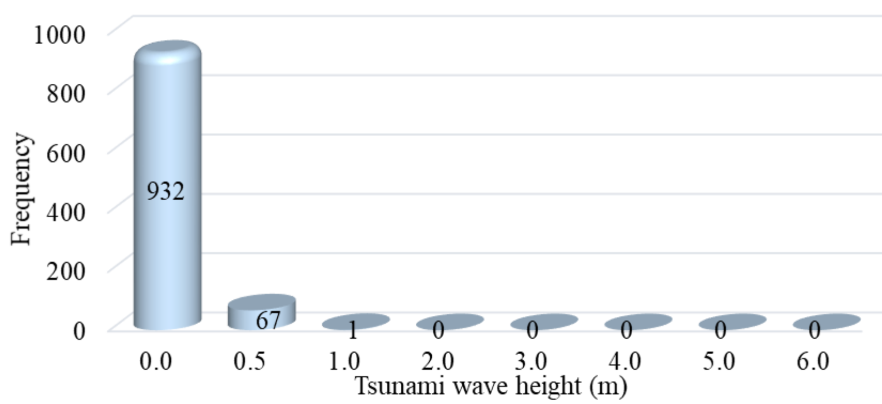

Figure D.74.1 Tsunami wave height frequency plot for Samandag Agricultural Area

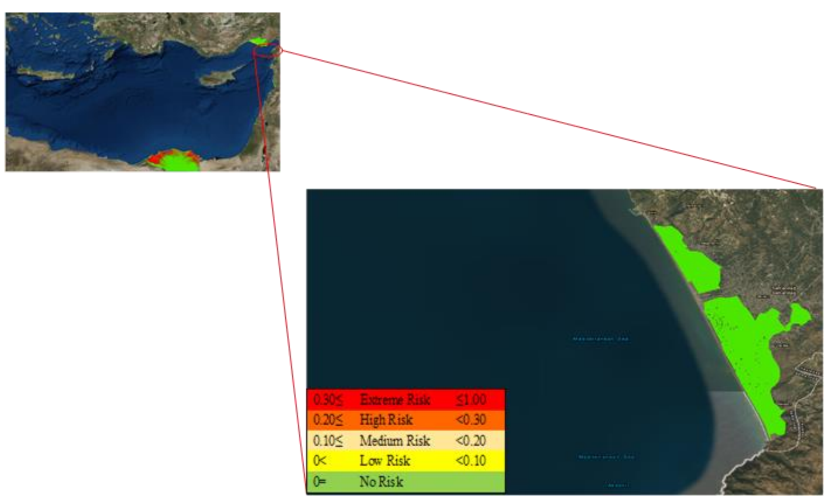

Figure D.74.2 Tsunami risk map for Samandag Agricultural Area

D.75 Information sheet for Tartus Agricultural Area

Table D.75 Economic and Social Damages Values for Tartus Agricultural Area

Inundation level (m)	Affected area (ha)	Economic damage ($1*10^6$€)	Social damage (NP)
0.50	-	-	1106
1.00	0	0	0
2.00	0	0	0
3.00	0	0	0
4.00	0	0	0
5.00	0	0	0
6.00	0	0	0

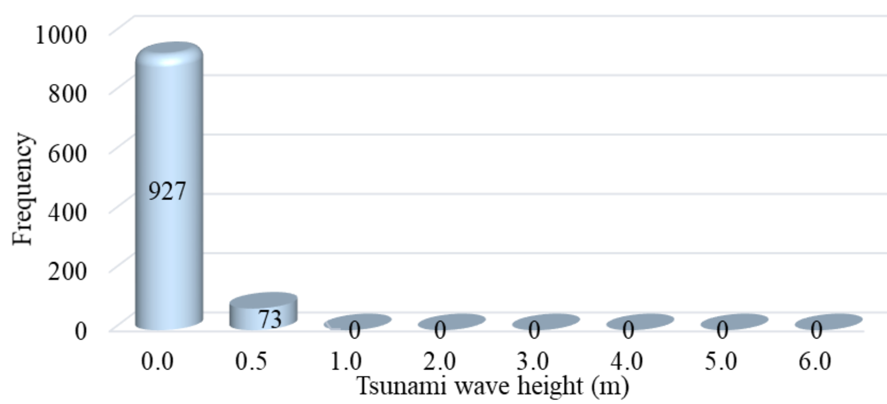

Figure D.75.1 Tsunami wave height frequency plot for Tartus Agricultural Area

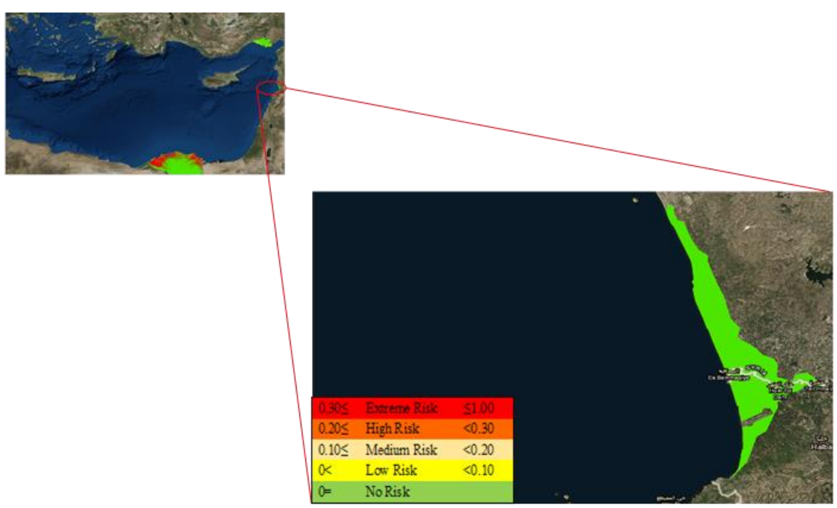

Figure D.75.2 Tsunami risk map for Tartus Agricultural Area

D.76 Information sheet for Akkuyu NPP Construction Site

Table D.76 Economic and Social Damages Values for Akkuyu NPP Construction Site

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	82125	13	
1.00	164250	26	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

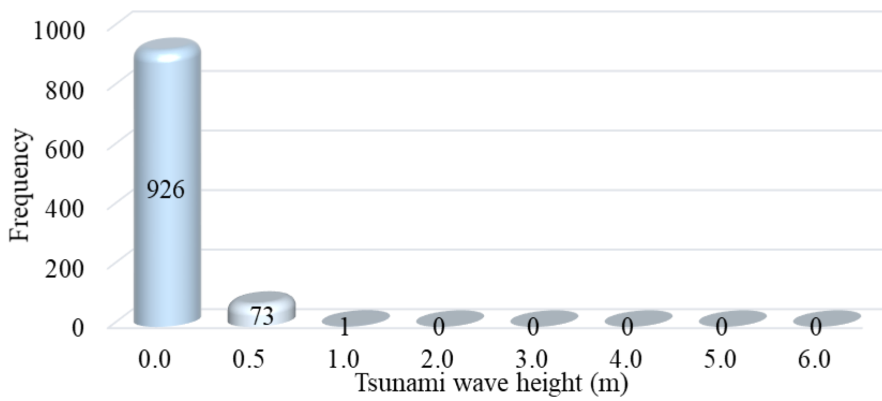

Figure D.76.1 Tsunami wave height frequency plot for Akkuyu NPP Construction Site

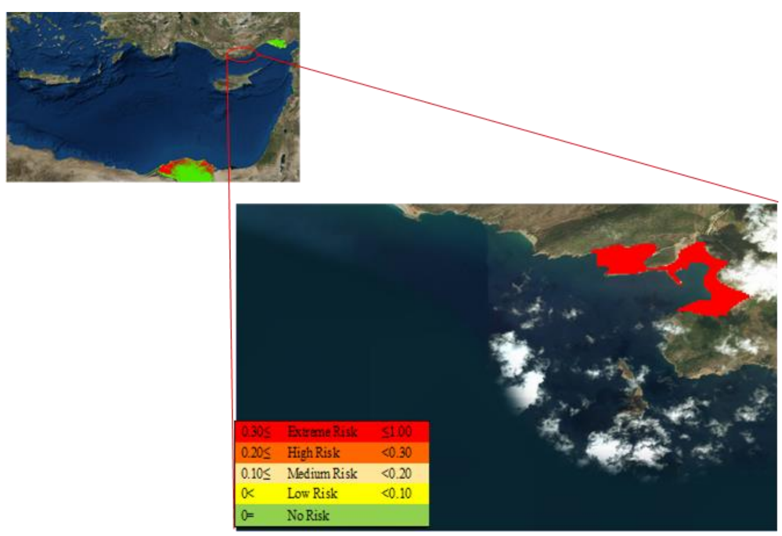

Figure D.76.2 Tsunami risk map for Akkuyu NPP Construction Site

D.77 Information sheet for Alexandria Oil Refinery

Table D.77 Economic and Social Damages Values for Alexandria Oil Refinery

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	254925	14	1
1.00	509850	28	
2.00	0	0	
3.00	0	0	
4.00	0	0	
5.00	0	0	
6.00	0	0	

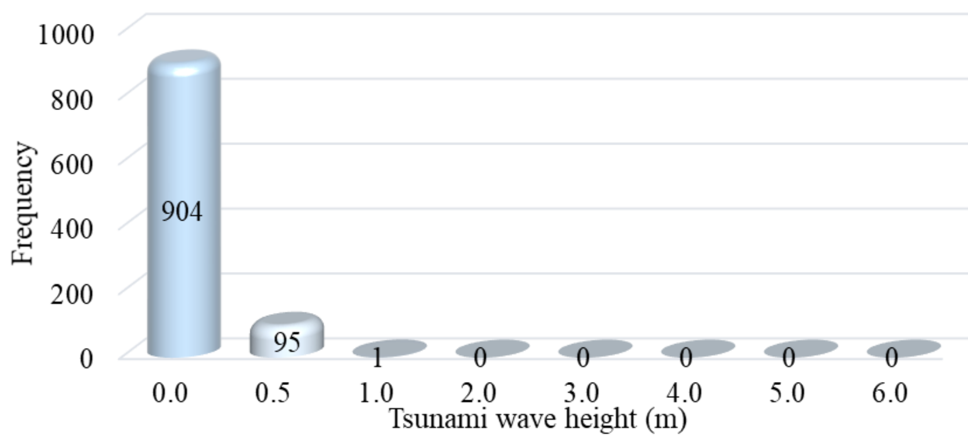

Figure D.77.1 Tsunami wave height frequency plot for Alexandria Oil Refinery

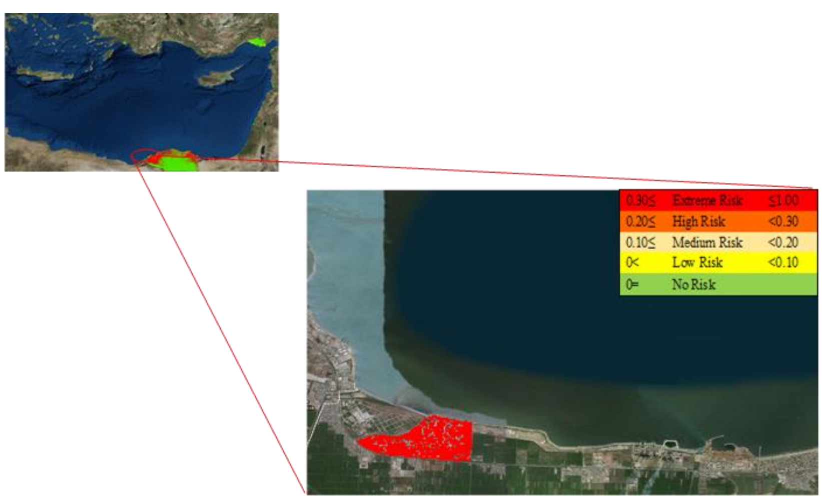

Figure D.77.2 Tsunami risk map for Alexandria Oil Refinery

D.78 Information sheet for Alpet Oil Filling Facility

Table D.78 Economic and Social Damages Values for Alpet Oil Filling Facility

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	1350	0.2	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

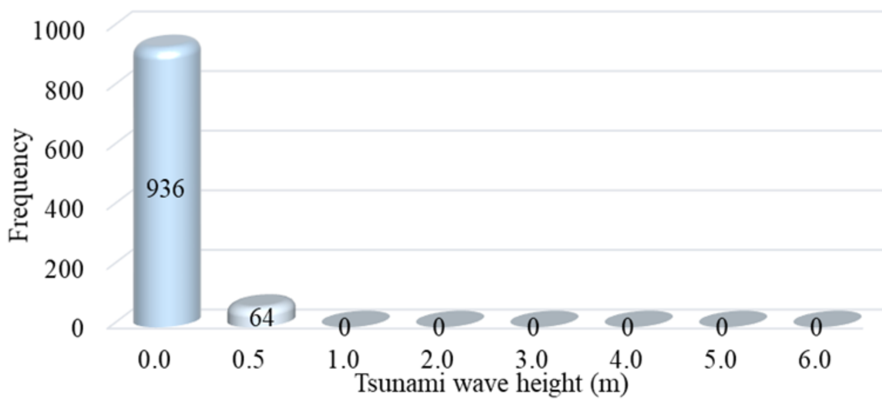

Figure D.78.1 Tsunami wave height frequency plot for Alpet Oil Filling Facility

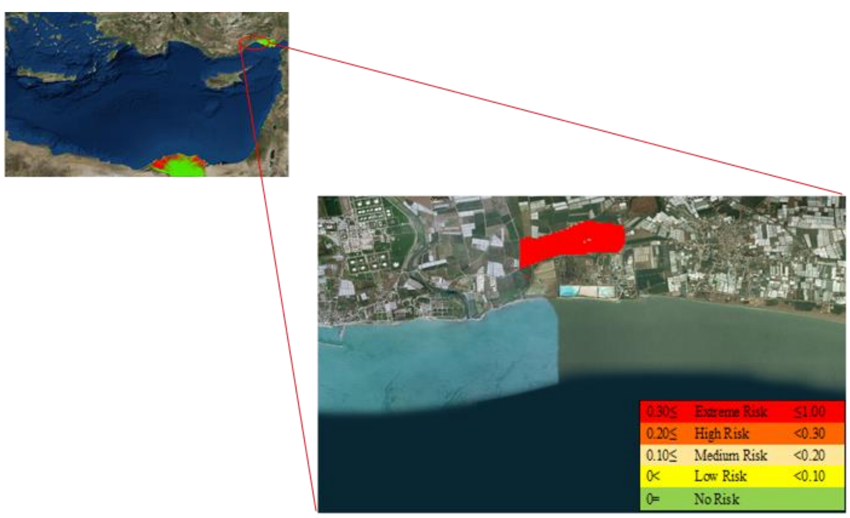

Figure D.78.2 Tsunami risk map for Alpet Oil Filling Facility

D79. Information sheet for IPT Terminals Aamchit

Table D.79 Economic and Social Damages Values for IPT Terminals Aamchit

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	0	0	
1.00	0	0	
2.00	0	0	
3.00	0	0	0
4.00	0	0	
5.00	0	0	
6.00	0	0	

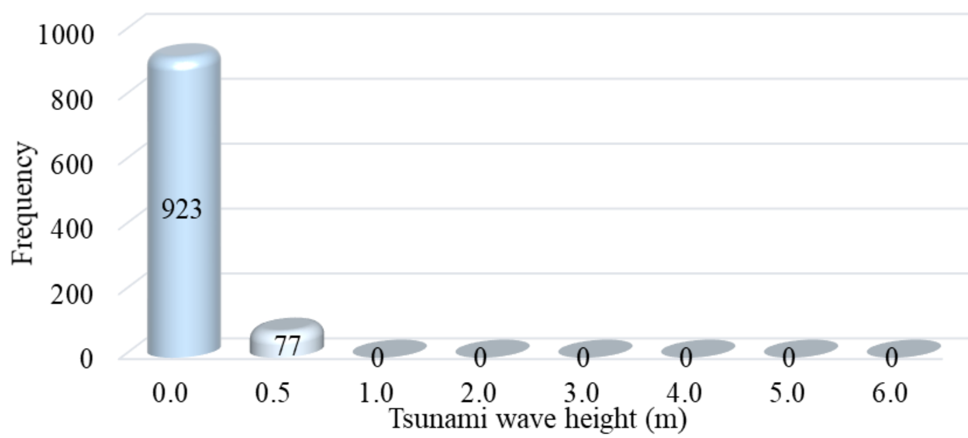

Figure D.79.1 Tsunami wave height frequency plot for IPT Terminals Aamchit

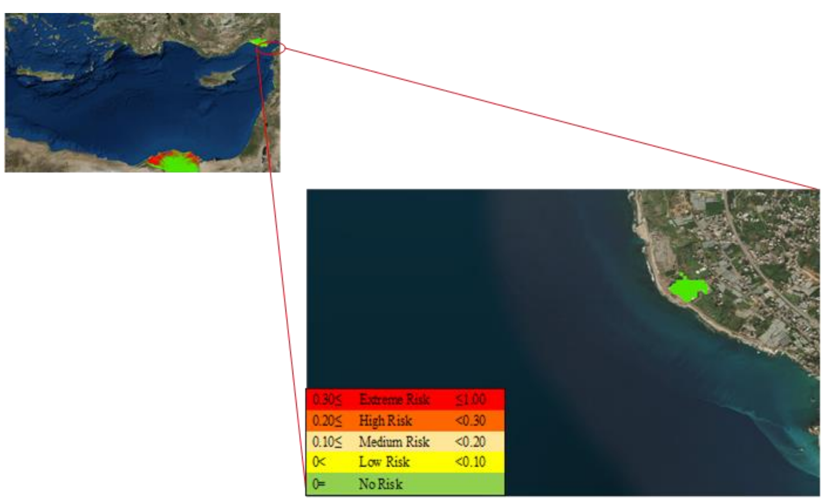

Figure D.79.2 Tsunami risk map for IPT Terminals Aamchit

D80 Information sheet for Antalya Waste Water Treatment Plant

Table D.80 Economic and Social Damages Values for Antalya WWTP

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	0	0	
1.00	0	0	
2.00	0	0	
3.00	0	0	0
4.00	0	0	
5.00	0	0	
6.00	0	0	

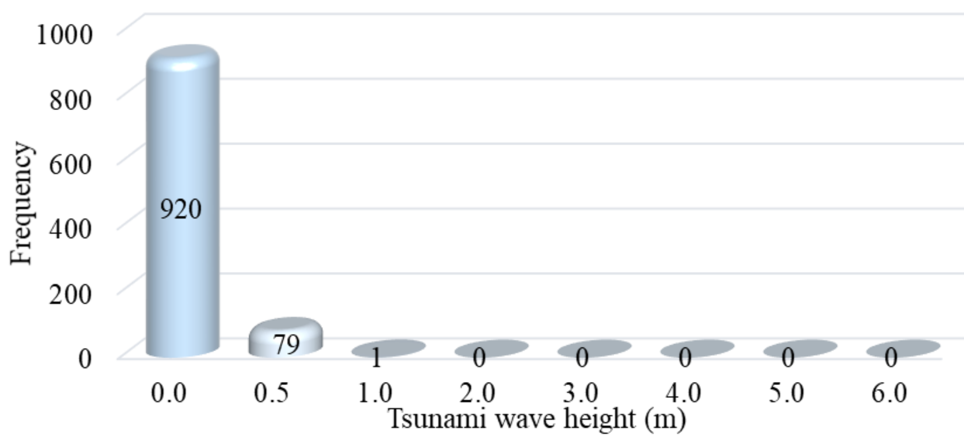

Figure D.80.1 Tsunami wave height frequency plot for Antalya WWTP

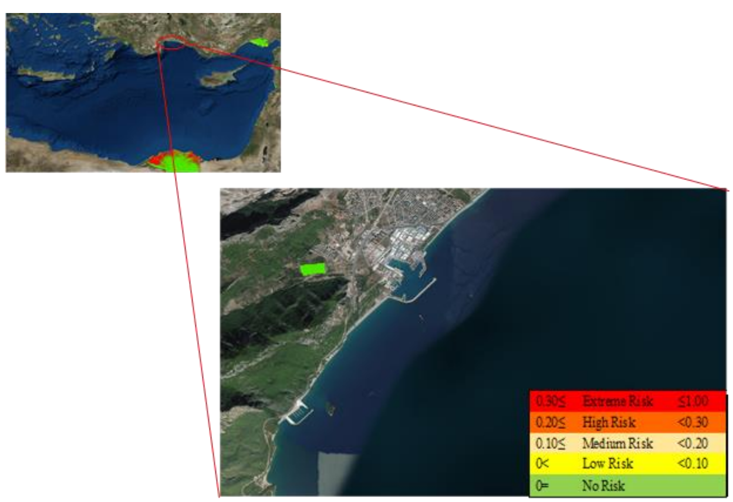

Figure D.80.2 Tsunami risk map for Antalya WWTP

D.81 Information sheet for Apec Oil Refinery

Table D.81 Economic and Social Damages Values for Apec Oil Refinery

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	3150	0.25	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

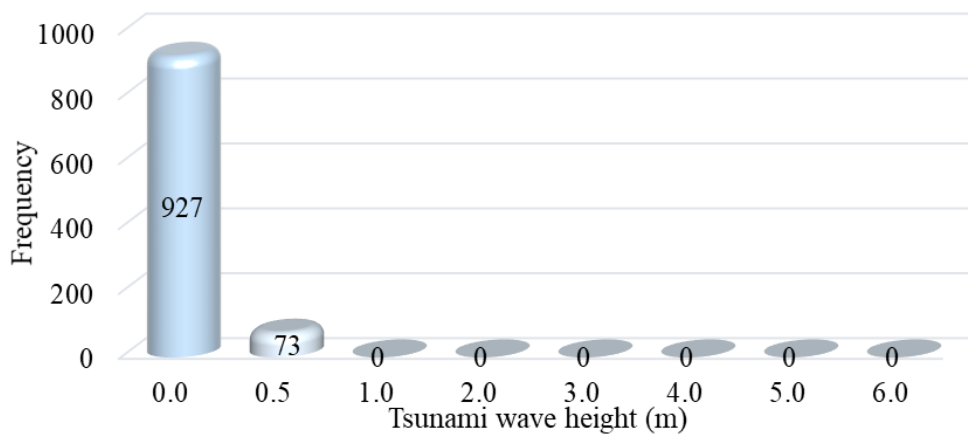

Figure D.81.1 Tsunami wave height frequency plot for Apec Oil Refinery

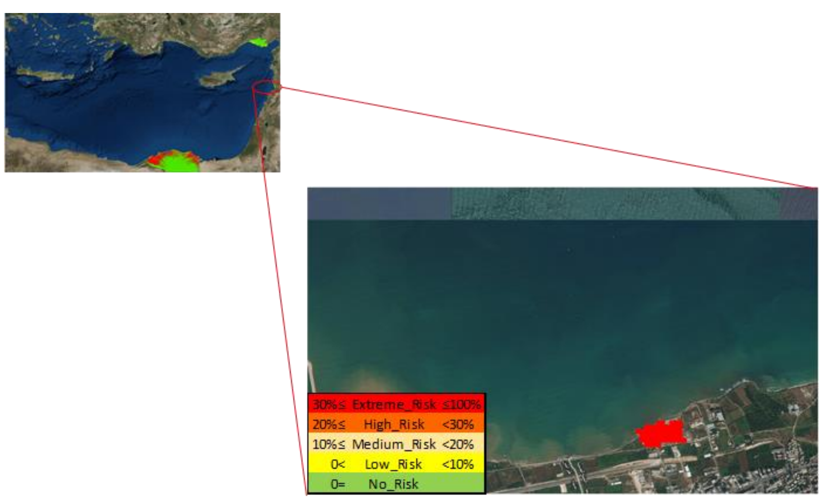

Figure D.81.2 Tsunami risk map for Apec Oil Refinery

D.82 Information sheet for Atas Oil Refinery

Table D.82 Economic and Social Damages Values for Atas Oil Refinery

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	0	0	
1.00	0	0	
2.00	0	0	
3.00	0	0	0
4.00	0	0	
5.00	0	0	
6.00	0	0	

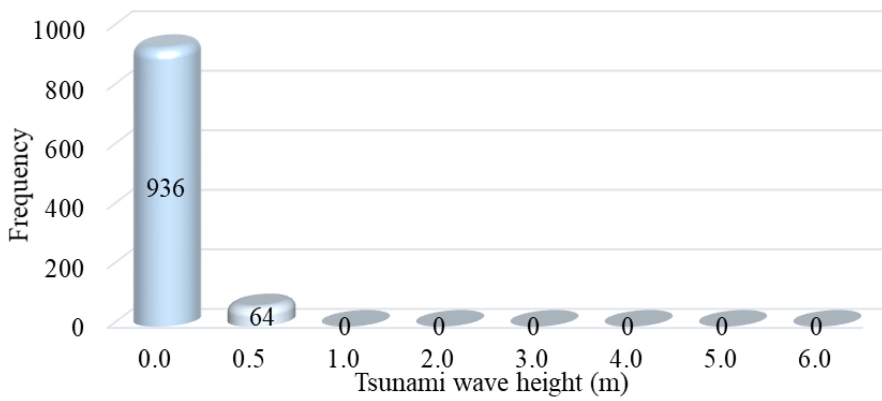

Figure D.82.1 Tsunami wave height frequency plot for Atas Oil Refinery

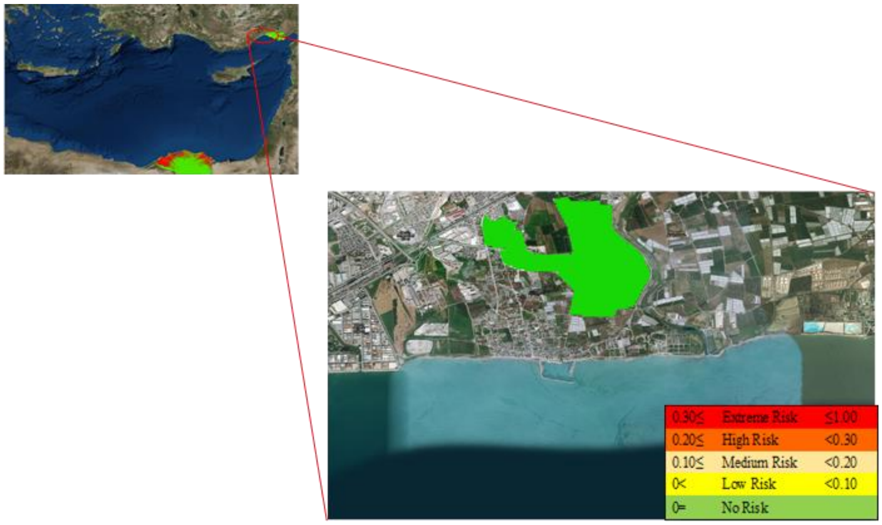

Figure D.82.2 Tsunami risk map for Atas Oil Refinery

D.83 Information sheet for Cimenterie Nationale Lebanon

Table D.83 Economic and Social Damages Values for Cimenterie Nationale

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	450	0.05	
1.00	900	0.1	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

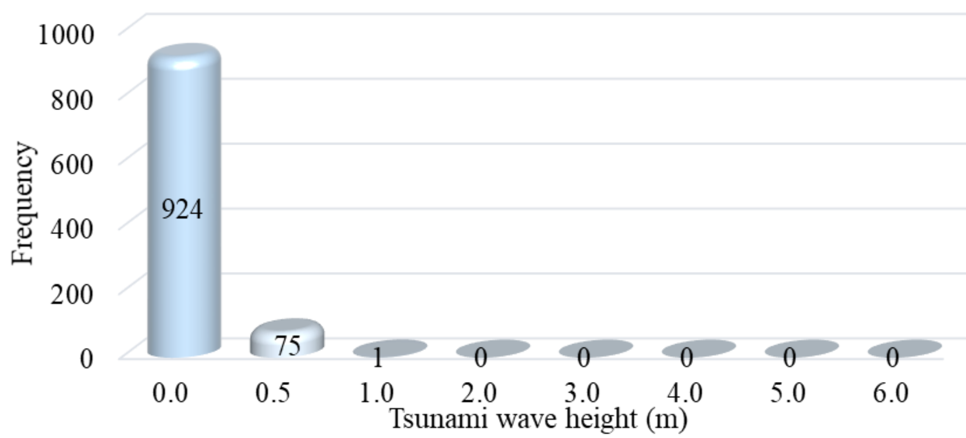

Figure D.83.1 Tsunami wave height frequency plot for Cimenterie Nationale

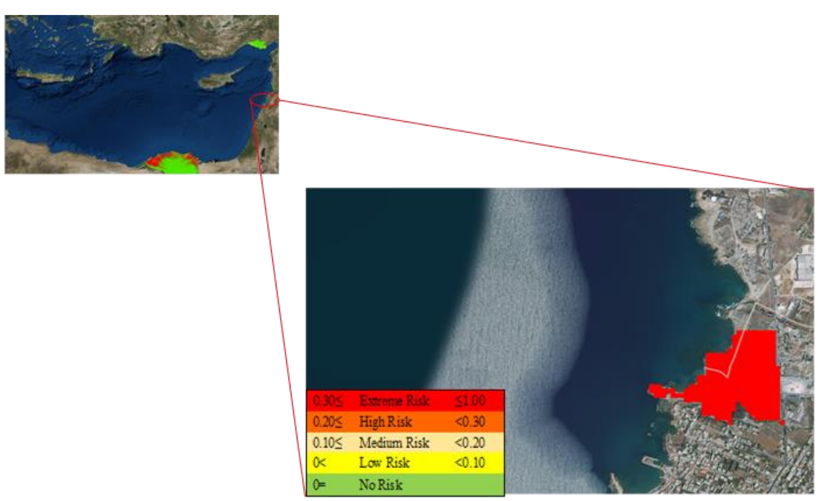

Figure D.83.2 Tsunami risk map for Cimenterie Nationale

D.84 Information sheet for Deir-Ammar CCGT Power Plant

Table D.84 Economic and Social Damages Values for Deir-Ammar CCGT Power Plant

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	900	0.05	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

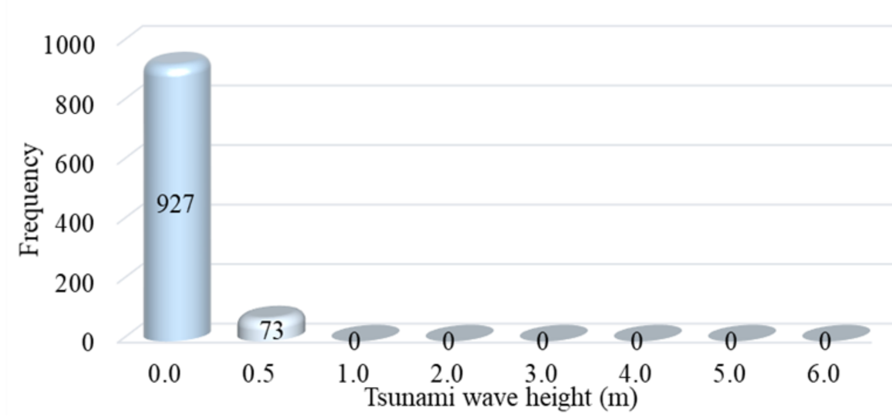

Figure D.84.1 Tsunami wave height frequency plot for Deir-Ammar CCGT Power Plant

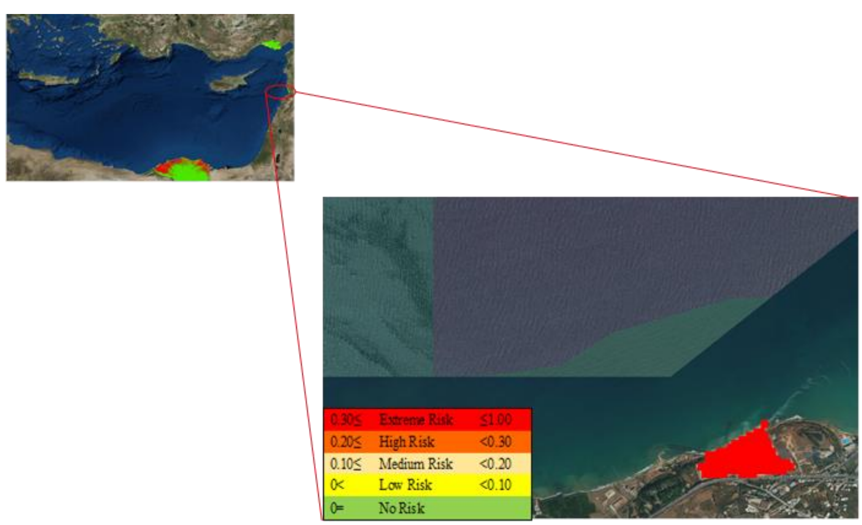

Figure D.84.2 Tsunami risk map for Deir-Ammar CCGT Power Plant

D.85 Information sheet for Iskenderun Iron and Steel Factory

Table D.85 Economic and Social Damages Values for Iskenderun Iron&Steel Factory

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	18450	1.5	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

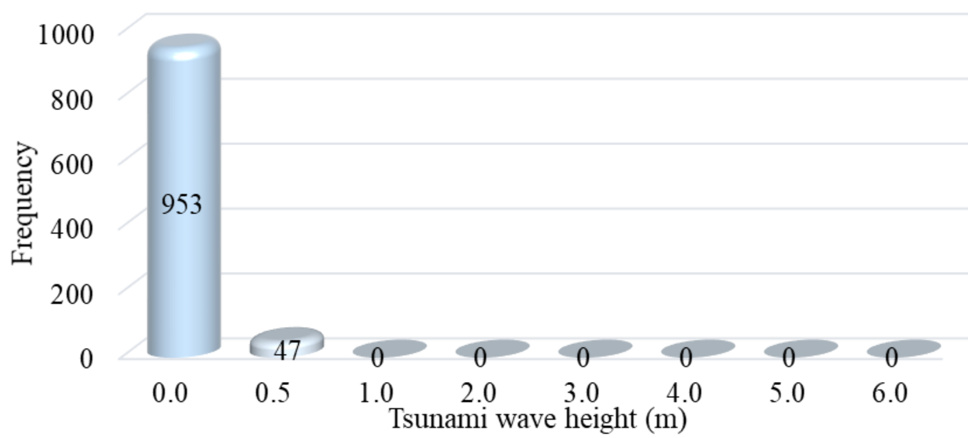

Figure D.85.1 Tsunami wave height frequency plot for Iskenderun Iron&Steel Factory

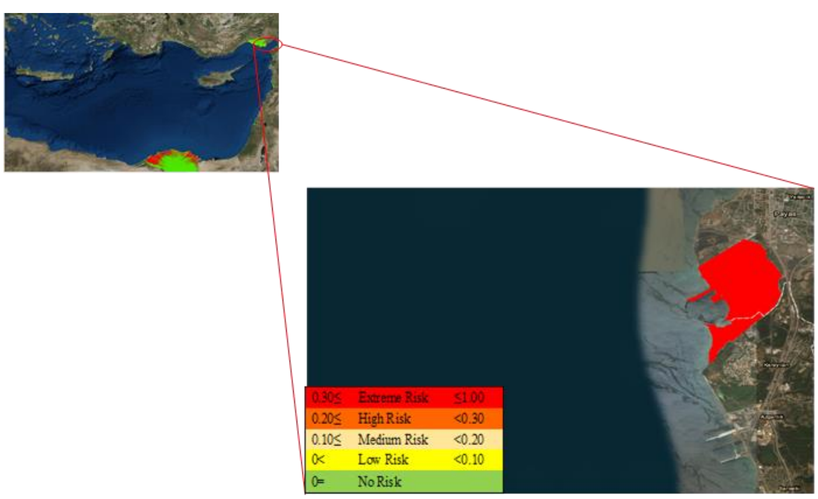

Figure D.85.2 Tsunami risk map for Iskenderun Iron&Steel Factory

D.86 Information sheet for Jiyyeh CCGT Power Plant

Table D.86 Economic and Social Damages Values for Jiyyeh CCGT Power Plant

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	12600	1	
1.00	25200	2	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

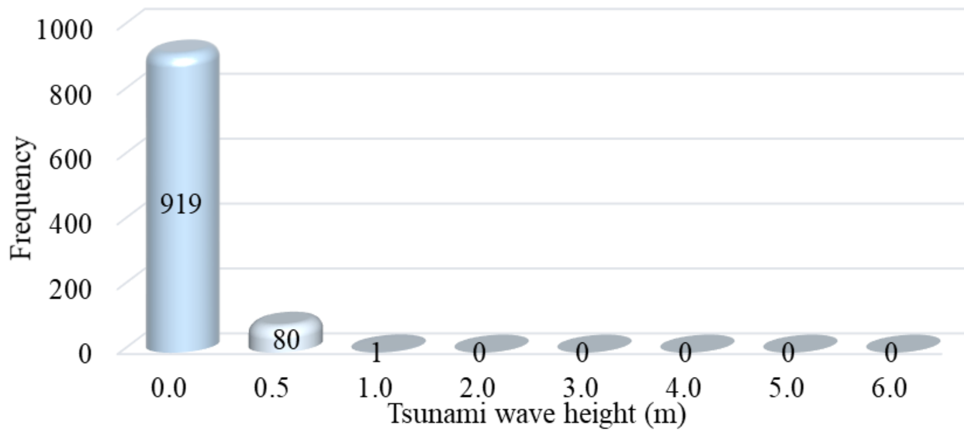

Figure D.86.1 Tsunami wave height frequency plot for Jiyyeh CCGT Power Plant

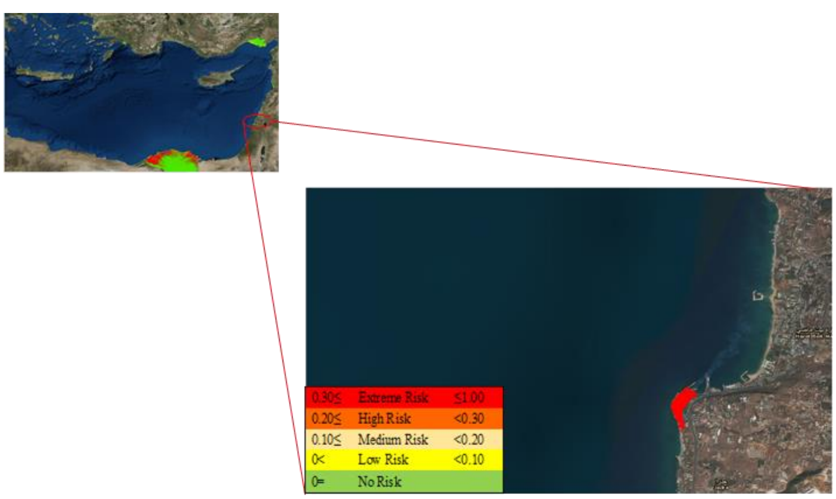

Figure D.86.2 Tsunami risk map for Jiyyeh CCGT Power Plant

D.87 Information sheet for Karaduvar Wastewater Treatment Plant

Table D.87 Economic and Social Damages Values for Karaduvar WWTP

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	1350	0.2	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

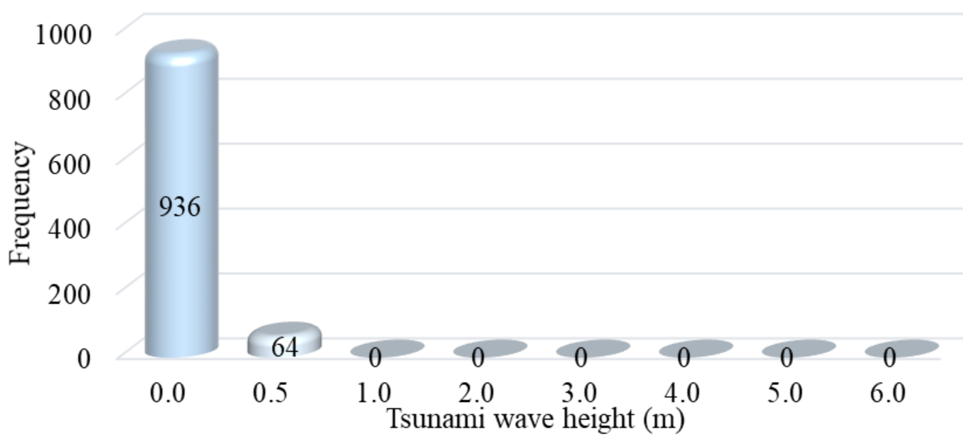

Figure D.87.1 Tsunami wave height frequency plot for Karaduvar WWTP

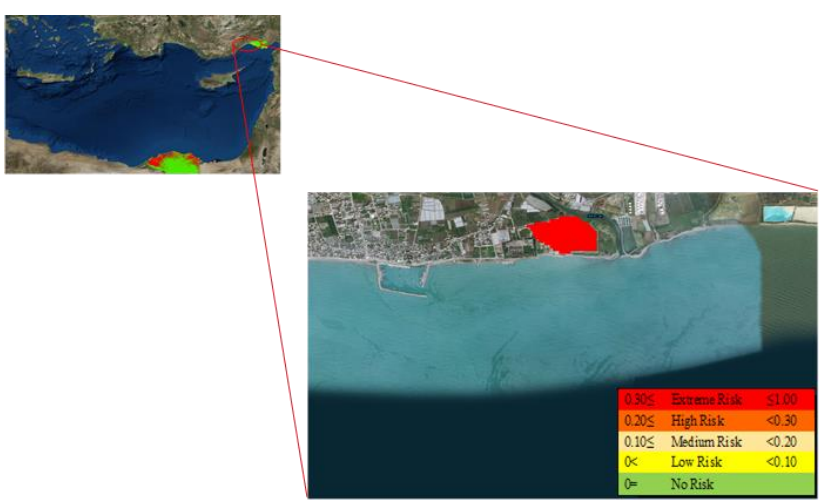

Figure D.87.2 Tsunami risk map for Karaduvar WWTP

D.88 Information sheet for Kemer Waste Water Treatment Plant

Table D.88 Economic and Social Damages Values for Kemer WWTP

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	0	0	
1.00	0	0	
2.00	0	0	
3.00	0	0	0
4.00	0	0	
5.00	0	0	
6.00	0	0	

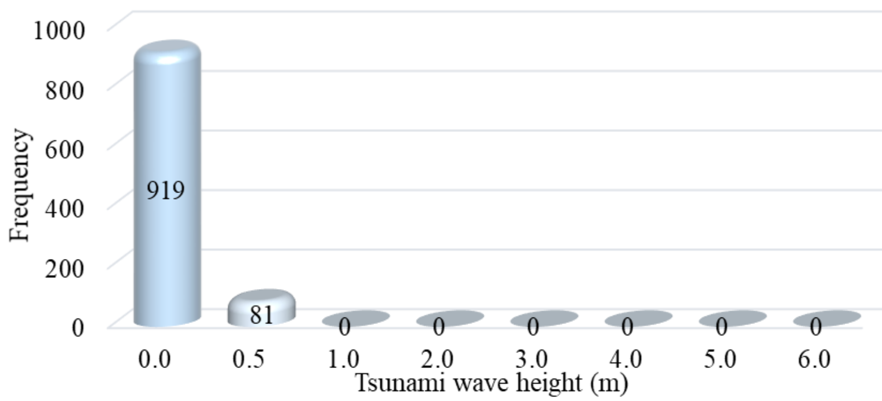

Figure D.88.1 Tsunami wave height frequency plot for Kemer WWTP

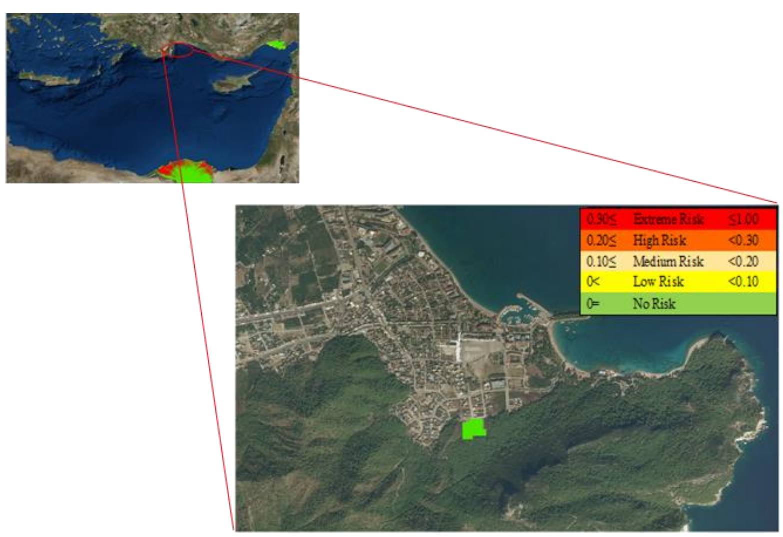

Figure D.88.2 Tsunami risk map for Kemer WWTP

D.89 Information sheet for Port Said Wastewater Treatment Plant

Table D.89 Economic and Social Damages Values for Port Said WWTP

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.50	12600	0.5	
1.00	25200	1	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

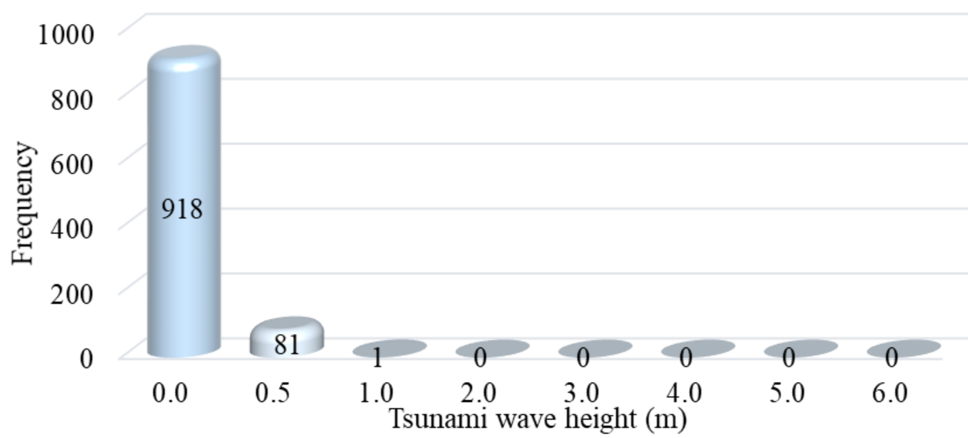

Figure D.89.1 Tsunami wave height frequency plot for Port Said WWTP

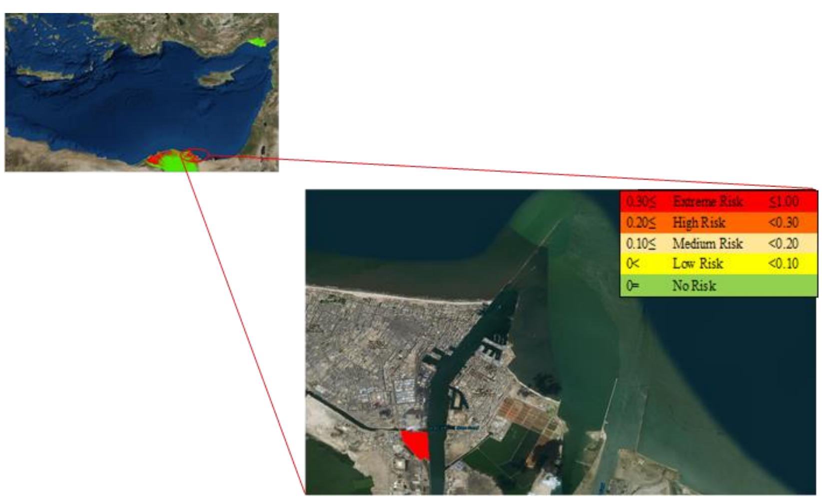

Figure D.89.2 Tsunami risk map for Port Said WWTP

D.90 Information sheet for Soda Chemical Industry

Table D.90 Economic and Social Damages Values for Soda Chemical Industry

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.5	9000	0.7	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

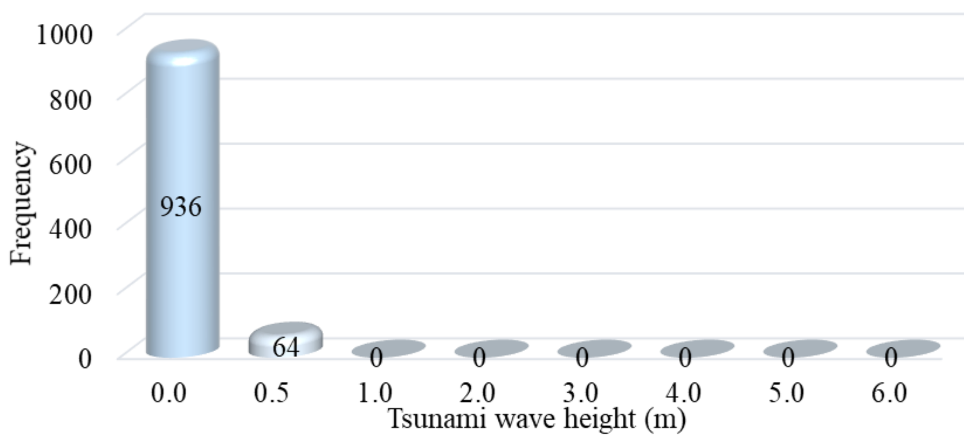

Figure D.90.1 Tsunami wave height frequency plot for Soda Chemical Industry

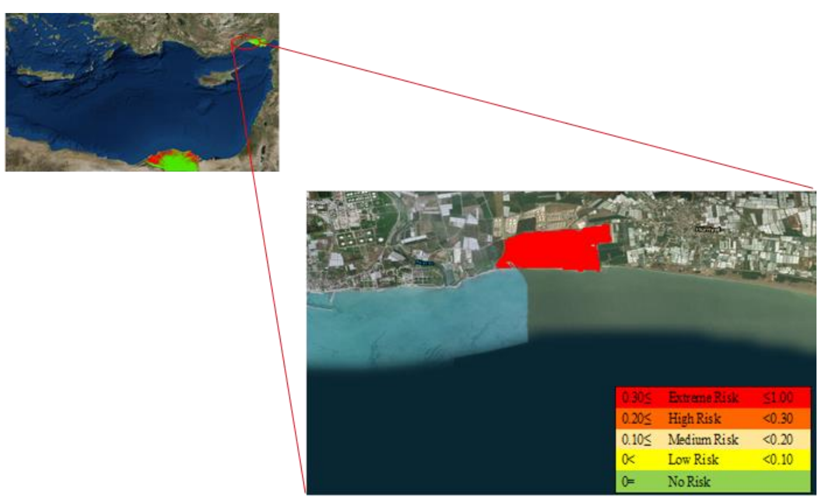

Figure D.90.2 Tsunami risk map for Soda Chemical Industry

D.91 Information sheet for Tripoli Wastewater Treatment Plant

Table D.91 Economic and Social Damages Values for Tripoli WWTP

Inundation level (m)	Affected area (m^2)	Economic damage ($1*10^6$€)	Environmental damage
0.5	22980	1.75	
1.00	0	0	
2.00	0	0	
3.00	0	0	1
4.00	0	0	
5.00	0	0	
6.00	0	0	

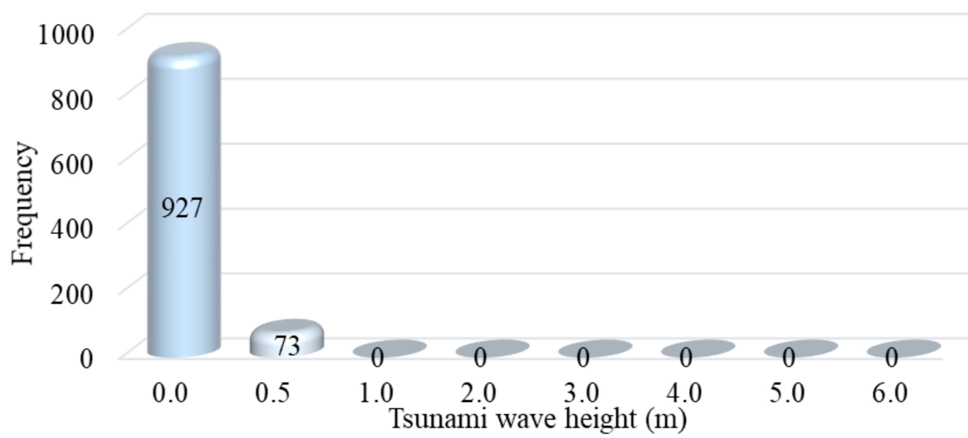

Figure D.91.1 Tsunami wave height frequency plot for Tripoli WWTP

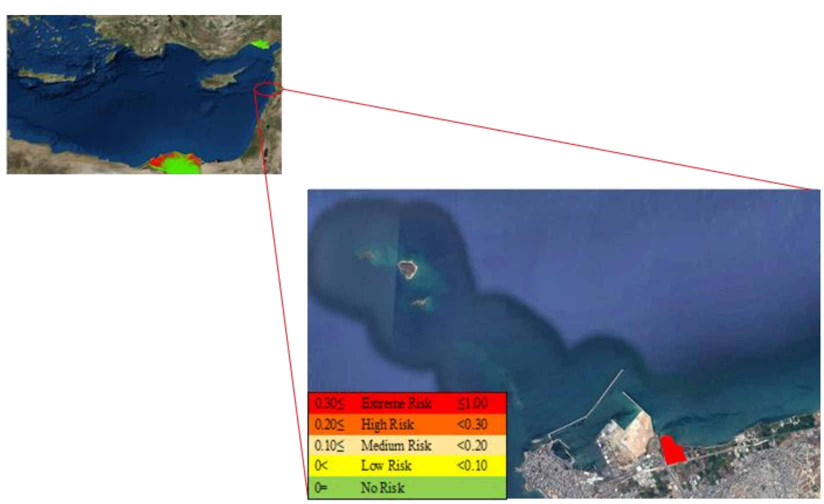

Figure D.91.2 Tsunami risk map for Tripoli WWTP

APPENDIX E - INFORMATION SHEETS FOR OVERALL RISK ASSESSMENT

Overall risk estimates of each EaR for the worst-case, equal weight and economic risk weighted scenarios as defined in Section 3.4.2.4 are given in this appendix. Overall risk estimates for residential buildings are given in Table E.1. Overall risk estimates for industrial buildings are given in Table E.2. Overall risk estimates for agricultural areas are given in Table E.3. Overall risk estimates for elements which is identified as an environmental hazards are given in Table E.4.

Table E.1 Information Table for Overall Risk Assessment of Residential buildings

	Overall Risk		
EaR ID	**Worst-case**	**Equal-weight**	**Economic risk weighted**
Akdeniz Summer Villages	0.01	0.00	0.00
Al Arish City Centre	0.03	0.01	0.02
Alanya Coastal District	0.06	0.02	0.03
Alexandria City Centre	0.75	0.26	0.39
Anamur Coastal District	0.00	0.00	0.00
Antalya Konyaalti	0.01	0.00	0.00
Arsuz Summer Villages	0.00	0.00	0.00
Batroun City Centre	0.00	0.00	0.00
Beirut City Centre	0.00	0.00	0.00
Belek Summer Villages	0.06	0.02	0.03
Crete Summer Villages	0.43	0.15	0.22
Dalaman City Centre	0.00	0.00	0.00
Demre City Centre	0.00	0.00	0.00
Erdemli City Centre	0.00	0.00	0.00
Fethiye City Centre	0.55	0.18	0.28
Finike City Centre	0.09	0.03	0.05
Gazimagusa City Centre	0.00	0.00	0.00
Haifa City Centre	0.07	0.02	0.04
Heraklion City Centre	0.21	0.07	0.11
Iskenderun City Centre	0.00	0.00	0.00
Kazanlı City Centre	0.00	0.00	0.00
Kemer City Centre	0.00	0.00	0.00
Kizkalesi Summer Villages	0.00	0.00	0.00
Larnaca City Centre	0.02	0.01	0.01
Latakia City Centre	0.00	0.00	0.00
Lebanon Summer Villages	0.00	0.00	0.00
Manavgat Coastal District	0.04	0.01	0.02
Mersa Matruh City Centre	0.02	0.01	0.01
Mersin City Centre	0.00	0.00	0.00
Nahariyya City Centre	0.01	0.00	0.00
Port Said City Centre	0.04	0.01	0.02
Samandag City Centre	0.00	0.00	0.00
Sariseki City Centre	0.00	0.00	0.00
Susanoglu Summer Villages	0.00	0.00	0.00
Tartus City Centre	0.00	0.00	0.00
Tartus Summer Villages	0.00	0.00	0.00
Tasucu City Centre	0.01	0.00	0.00
Tel Aviv City Centre	0.00	0.00	0.00
Tripoli City Centre	0.00	0.00	0.00
Turkler Summer Villages	0.01	0.00	0.00
Yemiskumu Summer Villages	0.00	0.00	0.00

Table E.2 Information Table for Overall Risk Assessment of Industrial facilities

EaR ID	Overall Risk		
	Worst-case	**Equal-weight**	**Economic risk weighted**
Abu Qir Industrial Zone	0.11	0.04	0.03
Abu Qir Port	0.02	0.01	0.01
Alexandria Airport	0.08	0.04	0.05
Ashdod Port	0.01	0.00	0.01
Ashkelon Seawater Desalination Plant	0.01	0.00	0.00
Beirut Airport	0.03	0.01	0.01
Beirut Port	0.02	0.01	0.00
Dalaman Airport	0.46	0.17	0.24
Gazimagusa Port	0.00	0.00	0.00
Haifa Airport	0.00	0.00	0.00
Haifa Port&Industrial Zone	0.06	0.02	0.03
Heraklion Airport	0.00	0.00	0.00
Herzliya Marina	0.00	0.00	0.00
Iskenderun Iron and Steel Port	0.00	0.00	0.00
Iskenderun Port	0.00	0.00	0.00
Koubba Industrial Zone	0.00	0.00	0.00
Larnaka Airport	0.11	0.04	0.03
Latakia Port	0.00	0.00	0.00
Marina Dbayeh	0.03	0.01	0.01
Mersin Port	0.00	0.00	0.00
MMK Metalurgy Port	0.00	0.00	0.00
Palmachi Air Base	0.09	0.03	0.05
Paphos International Airport	0.00	0.00	0.00
Port Akdeniz	0.08	0.03	0.02
Port Said Airport	0.01	0.00	0.01
Port Said	0.01	0.01	0.01
Tartus Port	0.01	0.01	0.01
Tirtar Yatch Marina	0.00	0.00	0.00
Tripoli Port	0.00	0.00	0.00

Table E.3 Information Table for Overall Risk Assessment of Agricultural regions

EaR ID	Overall Risk		
	Worst-case	**Equal-weight**	**Economic risk weighted**
Cairo Agricultural Area	1.00	0.67	0.75
Cukurova Agricultural Area	0.01	0.00	0.00
Dalaman Agricultural Area	0.00	0.00	0.00
Samandag Agricultural Area	0.00	0.00	0.00
Tartus Agricultural Area	0.00	0.00	0.00

Table E.4 Information Table for Overall Risk Assessment of EaR which may cause environmental damage

EaR ID	Overall Risk		
	Worst-case	**Equal-weight**	**Economic risk weighted**
Akkuyu NPP Construction Site	1.00	0.35	0.26
Alexandria Oil Refinery	1.00	0.41	0.31
Alpet Oil Filling Facility	1.00	0.33	0.25
Antalya WWTP	0.00	0.00	0.00
Apec Oil Refinery	1.00	0.33	0.25
Atas Oil Refinery	0.00	0.00	0.00
Cimenterie Nationale	1.00	0.33	0.25
Deir-Ammar CCGT Power Plant	1.00	0.33	0.25
IPT Terminals Aamchit	0.00	0.00	0.00
Iskenderun Iron and Steel Factory	1.00	0.33	0.25
Jiyeh CCGT Power Plant	1.00	0.33	0.25
Karaduvar WWTP	1.00	0.33	0.25
Kemer WWTP	0.00	0.00	0.00
Port Said WWTP	1.00	0.33	0.25
Soda Chemical Industry	1.00	0.33	0.25
Tripoli WWTP	1.00	0.33	0.25

APPENDIX F - COUNTRY LEVEL SOCIAL RISK CALCULATIONS

In this appendix, calculated social risks are summarized at country level. Social risk dimension at country level is given here to provide guidance for the country that wants to deploy a TEWS for its own sake. Element at considerably high social risk can be determined for the related country from the following tables. Social risks for Cyprus, Egypt, Greece, Israel, Lebanon, Syria and Turkey are given in Tables F.1 to F.7, respectively.

Table F.1 Social risk calculation for Cyprus

	Gazimagusa City Centre	Larnaca City Centre	Gazimagusa Port	Larnaka Airport	Paphos International Airport
$C_{vulnerability}$	0.78	0.85	1	1	1
Number of people	5	888	3	2050	17
	10	1776	6	4099	33
	34	4888	25	7135	199
	69	9812	65	9804	508
	111	15769	85	11907	1348
	146	21451	104	13597	2342
	181	26826	125	14706	4109
Tsunami wave height (m)	Frequency				
0.0	930	917	926	908	903
0.5	69	82	73	92	95
1.0	1	1	1	0	1
2.0	0	0	0	0	1
3.0	0	0	0	0	0
4.0	0	0	0	0	0
5.0	0	0	0	0	0
6.0	0	0	0	0	0
Tsunami wave height (m)	Social Risk				
0.5	0.4	85.7	0.2	188.6	1.6
1.0	0.0	2.1	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.2
3.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.5	87.8	0.2	188.6	1.8

Table F.2 Social risk calculation for Egypt

	Al-Arish City Centre	Alexandria City Centre	Mersa Matruh City Centre	Port Said City Centre	Abu Qir Industrial Zone	Abu Qir Port	Alexandria International Airport	Port Said Airport	Port Said Port	Cairo Agricultural Area	Alexandria Oil Refinery	Port Said Wastewater Treatment Plant
$C_{vulnerability}$	0.62	0.62	0.62	0.62	1	1	1	1	1	0.62	1	1
Number of people	1460	55099	718	641	1181	196	896	11	200	1165408	2425	1
	2920	110198	1437	1282	2363	391	1792	23	400	2330815	4849	3
	7805	137686	2167	1974	3062	542	1805	49	845	3284835	5153	12
	14596	167217	2832	2902	3620	663	1811	72	1443	4179886	5329	31
	22688	197225	3695	3981	4142	740	1816	93	2101	4978860	5372	47
	30016	227153	4736	5105	4525	801	1818	105	2665	5678665	5406	58
	78841	357852	6023	9157	5000	970	1820	121	3800	6855936	5500	73
Tsunami wave height (m)	Frequency											
0.0	931	908	910	922	904	904	904	918	918	911	904	918
0.5	68	91	89	77	95	95	95	81	81	88	95	81
1.0	0	1	1	1	1	1	1	1	1	1	1	1
2.0	1	0	0	0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk											
0.5	161.2	8139.4	103.8	80.1	112.2	18.6	85.1	0.9	16.2	166483.4	230.3	0.1
1.0	0.0	178.9	2.3	2.1	2.4	0.4	1.8	0.0	0.4	3783.7	4.8	0.0
2.0	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	173.8	8318.3	106.1	82.2	114.6	19.0	86.9	0.9	16.6	170267.1	235.2	0.1

Table F.3 Social risk calculation for Greece

	Crete Summer Villages	Heraklion City Centre	Heraklion Airport
$C_{vulnerability}$	0.77	0.77	1
Number of people	17816	512	0
	35631	1023	0
	48925	1453	0
	64850	2113	0
	81455	2829	0
	98269	3570	0
	114699	3999	10
Tsunami wave height (m)	Frequency		
0.0	919	923	919
0.5	76	72	76
1.0	3	3	3
2.0	2	1	1
3.0	0	1	1
4.0	0	0	0
5.0	0	0	0
6.0	0	0	0
Tsunami wave height (m)	Social Risk		
0.5	1769.6	48.1	0.0
1.0	139.7	4.0	0.0
2.0	127.9	1.9	0.0
3.0	0.0	2.8	0.0
4.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0
Total Risk	2037.2	56.8	0.0

Table F.4 Social risk calculation for Lebanon

	Batroun City Centre	Beirut City Centre	Lebanon Summer Villages	Tripoli City Centre	Beirut International Airport	Beirut Port	Koubba Industrial Zone	Marina Dbayeh	Tripoli Port	IPT Terminals Aamchit	Apec Oil Refinery	Cimenterie Nationale Lebanon	Deir-Ammar CCGT Power Plant	Jiyeh CCGT Power Plant	Tripoli Wastewater Treatment Plant
$C_{vulnerability}$	0.72	0.72	0.72	0.72	1	1	1	1	1	1	1	1	1	1	1
Number of people	4	318	2480	1658	531	284	12	453	89	0	36	4	43	40	4
	8	635	4959	3316	1061	567	24	905	179	0	71	7	85	80	9
	10	1305	7924	6477	2387	764	47	1068	298	0	132	43	383	102	17
	14	1924	10889	9878	3749	923	63	1230	386	0	244	100	852	119	27
	17	2644	13343	13093	5264	1035	75	1277	458	0	428	193	1193	159	37
	21	3439	15465	15894	7260	1095	91	1277	508	33	468	350	1491	239	40
	25	4461	16999	18315	9261	1138	110	1300	550	130	499	550	2300	304	45
Tsunami wave height (m)	Frequency														
0.0	928	923	928	930	919	919	923	919	926	923	927	924	927	919	927
0.5	72	77	72	70	81	81	77	81	74	77	73	75	73	80	73
1.0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk														
0.5	0.4	34.0	248.5	161.5	43.0	23.0	0.9	36.7	6.6	0.0	2.6	0.3	3.1	3.2	0.3
1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.4	34.0	248.5	161.5	43.0	23.0	0.9	36.7	6.6	0.0	2.6	0.3	3.1	3.3	0.3

Table F.5 Social risk calculation for Israel

	Haifa City Centre	Nahariya City Centre	Tel Aviv City Centre	Ashdod Port	Ashkelon Seawater Desalination Plant	Haifa Airport	Haifa Port&Industrial Zone	Herzliya Marina
$C_{vulnerability}$	0.98	0.98	0.98	1	1	1	1	1
Number of people	3476	466	192	43	10	9	123	85
	6952	931	383	86	20	19	246	169
	16174	1495	789	159	34	36	507	344
	30674	2397	1707	292	53	60	840	480
	49448	3687	3180	487	72	92	1174	569
	68368	5797	5030	773	98	125	1446	656
	109565	8567	9255	1972	261	181	1819	800
Tsunami wave height (m)	Frequency							
0.0	923	924	929	924	925	919	919	925
0.5	76	75	70	75	74	80	80	74
1.0	1	1	1	1	1	1	1	1
2.0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk							
0.5	270.9	35.8	13.8	3.2	0.8	0.7	9.9	6.3
1.0	7.1	1.0	0.4	0.1	0.0	0.0	0.2	0.2
2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	278.0	36.8	14.2	3.3	0.8	0.8	10.1	6.4

Table F.6 Social risk calculation for Syria

	Latakia City Centre	Tartus City Centre	Tartus Summer Villages	Latakia Port	Tartus Port	Tartus Agricultural Area
$C_{vulnerability}$	0.65	0.65	0.65	1	1	0.65
Number of people	3	19	9	45	157	1106
	7	38	17	90	314	2212
	14	51	52	264	587	5393
	47	71	112	569	984	10197
	105	107	225	1220	1585	15689
	223	152	366	2078	2185	21559
	448	220	582	3000	3000	33044
Tsunami wave height (m)	Frequency					
0.0	933	931	931	929	927	927
0.5	67	69	69	71	73	73
1.0	0	0	0	0	0	0
2.0	0	0	0	0	0	0
3.0	0	0	0	0	0	0
4.0	0	0	0	0	0	0
5.0	0	0	0	0	0	0
6.0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk					
0.5	0.4	2.0	0.9	3.2	11.5	124.9
1.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.4	2.0	0.9	3.2	11.5	124.9

Table F.7 Social risk calculation for Turkey

	Akdeniz Summer Villages	Alanya Coastal District	Anamur Coastal District	Antalya Konyaalti	Arsuz Summer Villages	Belek Summer Villages	Dalaman City Centre	Demre City Centre	Erdemli City Centre	Fethiye City Centre
$C_{vulnerability}$	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Number of people	3342	8164	29	390	8	4918	0	0	70	1531
	6684	16328	58	779	16	9836	0	0	140	3062
	17452	25806	156	1948	30	22791	0	0	419	5116
	34442	37805	326	3731	60	39070	0	0	915	7170
	56950	53586	501	6268	102	56970	0	4	1414	9657
	82325	70947	676	9163	163	74297	5	63	1993	12410
	188763	164936	817	12369	238	157447	50	169	3553	31042
Tsunami wave height (m)	Frequency									
0.0	941	922	919	925	940	924	911	909	937	911
0.5	58	77	80	74	60	75	83	89	62	82
1.0	1	0	1	1	0	1	4	2	1	3
2.0	0	1	0	0	0	0	2	0	0	3
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	1
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk									
0.5	260.2	843.8	3.1	38.7	0.6	495.1	0.0	0.0	5.8	168.5
1.0	9.0	0.0	0.1	1.0	0.0	13.2	0.0	0.0	0.2	12.3
2.0	0.0	34.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.6
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	269.2	878.4	3.2	39.7	0.6	508.3	0.0	0.0	6.0	214.4

Table F.7 Social risk calculation for Turkey (continued)

	Finike City Centre	Iskenderun City Centre	Kazanlı City Centre	Kemer City Centre	Kizkalesi Summer Villages	Manavgat Coastal District	Mersin City Centre	Samandag City Centre	Sariseki City Centre	Susanoglu Summer Villages
$C_{vulnerability}$	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Number of people	195	353	77	832	1	1653	43	1	1	3783
	389	707	155	1665	1	3305	85	2	2	7565
	831	1451	516	5303	15	7345	198	8	4	15592
	1226	2530	1039	13381	35	12721	360	24	9	22380
	1516	3887	1683	27194	86	18808	604	65	17	27438
	1716	5471	2191	47234	173	24578	946	122	30	31318
	1905	12397	2565	92372	293	35734	7883	214	97	33610
Tsunami wave height (m)	Frequency									
0.0	915	956	940	923	936	921	940	936	955	935
0.5	82	44	60	77	63	78	60	63	45	65
1.0	2	0	0	0	1	1	0	1	0	0
2.0	1	0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk									
0.5	21.4	20.9	6.2	86.0	0.1	173.0	3.4	0.1	0.1	330.0
1.0	1.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0
2.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	23.6	20.9	6.2	86.0	0.1	177.5	3.4	0.1	0.1	330.0

Table F.7 Social risk calculation for Turkey (continued)

	Tasucu City Centre	Turkler Summer Villages	Yemiskumu Summer Villages	Dalaman Airport	Iskenderun Iron and Steel Port	Iskenderun Port	Mersin Port	MMK Metalurgy Port	Port Akdeniz	Tirtar Yacht Marina
$C_{vulnerability}$	0.75	0.75	0.75	1	1	1	1	1	1	1
Number of people	6	670	8	627	65	11	36	4	1423	0
	11	1339	15	1254	129	23	72	8	2846	0
	33	3294	48	3190	337	52	220	19	6609	0
	67	6358	84	5098	636	98	377	35	11137	50
	113	9808	144	6954	991	149	538	74	15740	300
	159	13630	245	8706	1420	194	675	128	19665	300
	230	20519	367	10112	3286	300	1410	796	21918	400
Tsunami wave height (m)	Frequency									
0.0	930	918	937	907	953	954	936	953	920	933
0.5	69	81	63	87	47	46	64	47	79	66
1.0	1	1	0	4	0	0	0	0	1	1
2.0	0	0	0	2	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk									
0.5	0.5	72.8	0.7	54.6	3.0	0.5	2.3	0.2	112.4	0.0
1.0	0.0	1.8	0.0	5.0	0.0	0.0	0.0	0.0	2.8	0.0
2.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.5	74.6	0.7	66.0	3.0	0.5	2.3	0.2	115.3	0.0

Table F.7 Social risk calculation for Turkey (continued)

	Cukurova Agricultural Area	Dalaman Agricultural Area	Samandag Agricultural Area	Akkuyu NPP Construction Site	Alpet Oil Filling Facility	Antalya Lara Wastewater Treatment Plant	Atas Oil Refinery	Iskenderun Iron and Steel Factory	Karaduvar Wastewater Treatment Plant	Kemer Wastewater Treatment Plant	Soda Chemical Industry
$C_{vulnerability}$	0.75	0.75	0.75	1	1	1	1	1	1	1	1
Number of people	8593	657	118	664	0	0	0	43	1	0	23
	17185	1313	237	1328	0	0	0	85	1	0	46
	35372	4434	909	1405	1	1	0	177	9	0	202
	53266	8906	2011	1543	4	5	1	356	23	0	530
	68346	13928	3091	1722	10	8	2	582	33	0	938
	80178	18929	3886	1987	17	18	6	944	37	2	1389
	155506	24661	4497	3774	29	44	400	5262	47	18	2918
Tsunami wave height (m)	Frequency										
0.0	933	907	932	926	936	920	936	953	936	919	936
0.5	67	87	67	73	64	79	64	47	64	81	64
1.0	0	4	1	1	0	1	0	0	0	0	0
2.0	0	2	0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0	0
Tsunami wave height (m)	Social Risk										
0.5	772.8	76.7	10.6	48.5	0.0	0.0	0.0	2.0	0.0	0.0	1.5
1.0	0.0	7.1	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	772.8	95.6	11.0	49.8	0.0	0.0	0.0	2.0	0.0	0.0	1.5

APPENDIX G - SOCIAL RISK REDUCTION AND TEWS POSITIONING

In this appendix, social risk values and maximum required time to reach the safe altitude for each EaR are shown in Table G1 and Table G2, respectively. Additionally, data showing the selected TEWS locations, risky earthquake epicenters, Estimated Time of Arrival (ETA) from earthquake epicenter to TEWS and to EwHSR, required time to reach the safe altitude for each EwHSR (t_R), remaining time to move to safe altitude for each EwHSR (t_A), risk reduction coefficient for each EwHSR (C_R) after TEWS installation, social risk calculation with and without TEWS deployment, risk reduction percentages of EwHSR according to risky earthquakes and risk reduction percentage by averaging for all EwHSR and risky earthquakes are given in Tables G3 to G10, respectively.

Table G.1 Normalized social risk values for each EaR in the study area

	Akdeniz Summer Villages	Al-Arish City Centre	Alanya Coastal District	Alexandria City Centre	Anamur Coastal District	Antalya Konyaalti	Arsuz Summer Villages	Batroun City Centre	Beirut City Centre	Belek Summer Villages	Crete Summer Villages	Dalaman City Centre	Demre City Centre	Erdemli City Centre	Fethiye City Centre
C_{vul}	1.46	1.91	1.46	1.91	1.46	1.46	1.46	1.51	1.51	1.46	1.31	1.46	1.46	1.46	1.46
NP	3342	1460	8164	55099	29	390	8	4	318	4918	17816	0	0	70	1531
	6684	2920	16328	110198	58	779	16	8	635	9836	35631	0	0	140	3062
	17452	7805	25806	137686	156	1948	30	10	1305	22791	48925	0	0	419	5116
	34442	14596	37805	167217	326	3731	60	14	1924	39070	64850	0	0	915	7170
	56950	22688	53586	197225	501	6268	102	17	2644	56970	81455	0	4	1414	9657
	82325	30016	70947	227153	676	9163	163	21	3439	74297	98269	5	63	1993	12410
	188763	78841	164936	357852	817	12369	238	25	4461	157447	114699	50	169	3553	31042
Inundation level (m)	Frequency														
0.00	941	931	920	908	919	925	940	928	923	924	919	911	909	937	911
0.50	58	68	77	91	80	74	60	72	77	75	76	83	89	62	82
1.00	1	0	1	1	1	1	0	0	0	1	3	4	2	1	3
2.00	0	1	1	0	0	0	0	0	0	0	2	2	0	0	3
3.00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk														
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00

Table G.1 Normalized social risk values for each EaR in the study area (continued)

	Finike City Centre	Gazimagusa City Centre	Haifa City Centre	Heraklion City Centre	Iskenderun City Centre	Kazanlı City Centre	Kemer City Centre	Kizkalesi Summer Villages	Larnaca City Centre	Latakia City Centre	Lebanon Summer Villages	Manavgat Coastal District	Mersa Matruh City Centre	Mersin City Centre	Nahariya City Centre
C_{vul}	1.46	1.20	1.09	1.31	1.46	1.46	1.46	1.46	1.21	1.83	1.51	1.46	1.91	1.46	1.09
	195	5	3476	512	353	77	832	1	888	3	2480	1653	718	43	466
	389	10	6952	1023	707	155	1665	1	1776	7	4959	3305	1437	85	931
	831	34	16174	1453	1451	516	5303	15	4888	14	7924	7345	2167	198	1495
NP	1226	69	30674	2113	2530	1039	13381	35	9812	47	10889	12721	2832	360	2397
	1516	111	49448	2829	3887	1683	27194	86	15769	105	13343	18808	3695	604	3687
	1716	146	68368	3570	5471	2191	47234	173	21451	223	15465	24578	4736	946	5797
	1905	181	109565	3999	12397	2565	92372	293	26826	448	16999	35734	6023	7883	8567
Inundation level (m)	Frequency														
0.00	915	930	923	923	956	940	923	936	917	933	928	921	910	940	924
0.50	82	69	76	72	44	60	77	63	82	67	72	78	89	60	75
1.00	2	1	1	3	0	0	0	1	1	0	0	1	1	0	1
2.00	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
3.00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk														
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table G.1 Normalized social risk values for each EaR in the study area (continued)

	Port Said City Centre	Samandag City Centre	Sariseki City Centre	Susanoglu Summer Villages	Tartus City Centre	Tartus Summer Villages	Tasucu City Centre	Tel Aviv City Centre	Tripoli City Centre	Turkler Summer Villages	Yemiskumu Summer Villages	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Agricultural Area	Samandag Agricultural Area
C_{vul}	1.91	1.46	1.46	1.46	1.83	1.83	1.46	1.09	1.51	1.46	1.46	1.91	1.46	1.46	1.46
	641	1	1	3783	19	9	6	192	1658	670	8	1165408	8593	657	118
	1282	2	2	7565	38	17	11	383	3316	1339	15	2330815	17185	1313	237
	1974	8	4	15592	51	52	33	789	6477	3294	48	3284835	35372	4434	909
NP	2902	24	9	22380	71	112	67	1707	9878	6358	84	4179886	53266	8906	2011
	3981	65	17	27438	107	225	113	3180	13093	9808	144	4978860	68346	13928	3091
	5105	122	30	31318	152	366	159	5030	15894	13630	245	5678665	80178	18929	3886
	9157	214	97	33610	220	582	230	9255	18315	20519	367	6855936	155506	24661	4497
Inundation level (m)	Frequency														
0.00	922	936	955	935	931	931	930	929	930	918	937	911	933	907	932
0.50	77	63	45	65	69	69	69	70	70	81	63	88	67	87	67
1.00	1	1	0	0	0	0	1	1	0	1	0	1	0	4	1
2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk														
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00

Table G.1 Normalized social risk values for each EaR in the study area (continued)

	Tartus Agricultural Area	Abu Qir Industrial Zone	Abu Qir Port	Alexandria Airport	Ashdod Port	Ashkelon Seawater Desalination Plant	Beirut Airport	Beirut Port	Dalaman Airport	Gazimagusa Port	Haifa Airport	Haifa Port&Industrial Zone	Heraklion Airport	Herzliya Marina	Iskenderun Iron and Steel Port
C_{vul}	1.83	1.91	1.91	1.91	1.09	1.09	1.43	1.43	1.46	1.46	1.09	1.09	1.21	1.09	1.46
	1106	1181	196	896	43	10	531	284	627	3	9	123	0	85	65
	2212	2363	391	1792	86	20	1061	567	1254	6	19	246	0	169	129
	5393	3062	542	1805	159	34	2387	764	3190	25	36	507	0	344	337
NP	10197	3620	663	1811	292	53	3749	923	5098	65	60	840	0	480	636
	15689	4142	740	1816	487	72	5264	1035	6954	85	92	1174	0	569	991
	21559	4525	801	1818	773	98	7260	1095	8706	104	125	1446	0	656	1420
	33044	5000	970	1820	1972	261	9261	1138	10112	125	181	1819	10	800	3286
Inundation level (m)	Frequency														
0.00	927	904	904	904	924	925	919	919	907	926	919	919	919	925	953
0.50	73	95	95	95	75	74	81	81	87	73	80	80	76	74	47
1.00	0	1	1	1	1	1	0	0	4	1	1	1	3	1	0
2.00	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk														
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table G.1 Normalized social risk values for each EaR in the study area (continued)

	Iskenderun Port	Koubba Industrial Zone	Larnaka Airport	Latakia Port	Marina Dbayeh	Mersin Port	MMK Metalurgy Port	Palmachi Air Base	Paphos International Airport	Port Akdeniz	Port Said Airport	Port Said Port	Tartus Port	Tirtar Yacht Marina	Tripoli Port
C_{vul}	1.46	1.51	1.16	1.83	1.51	1.46	1.46	1.09	1.16	1.46	1.66	1.66	1.83	1.46	1.51
NP	11	12	2050	45	453	36	4	NO INFO	17	1423	11	200	157	0	89
	23	24	4099	90	905	72	8		33	2846	23	400	314	0	179
	52	47	7135	264	1068	220	19		199	6609	49	845	587	0	298
	98	63	9804	569	1230	377	35		508	11137	72	1443	984	50	386
	149	75	11907	1220	1277	538	74		1348	15740	93	2101	1585	300	458
	194	91	13597	2078	1277	675	128		2342	19665	105	2665	2185	300	508
	300	110	14706	3000	1300	1410	796		4109	21918	121	3800	3000	400	550
Inundation level (m)	Frequency														
0.00	954	923	908	929	919	936	953	921	903	920	918	918	927	933	926
0.50	46	77	92	71	81	64	47	77	95	79	81	81	73	66	74
1.00	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0
2.00	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk														
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NO INFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table G.1 Normalized social risk values for each EaR in the study area (continued)

	Akkuyu NPP Construction Site	Alexandria Oil Refinery	Alpet Oil Filling Facility	IPT Terminals Aamchit	Antalya Lara Wastewater Treatment Plant	Apec Oil Refinery	Atas Oil Refinery	Cimenterie Nationale Lebanon	Deir-Ammar CCGT Power Plant	Iskenderun Iron and Steel Factory	Jiyeh CCGT Power Plant	Karaduvar Wastewater Treatment Plant	Kemer Wastewater Treatment Plant	Port Said Wastewater Treatment Plant	Soda Chemical Industry	Tripoli Wastewater Treatment Plant
C_{vul}	1.46	1.91	1.46	1.51	1.46	1.51	1.46	1.51	1.51	1.46	1.51	1.46	1.46	1.91	1.46	1.51
	664	2425	0	0	0	36	0	4	43	43	40	1	0	1	23	4
	1328	4849	0	0	0	71	0	7	85	85	80	1	0	3	46	9
	1405	5153	1	0	1	132	0	43	383	177	102	9	0	12	202	17
NP	1543	5329	4	0	5	244	1	100	852	356	119	23	0	31	530	27
	1722	5372	10	0	8	428	2	193	1193	582	159	33	0	47	938	37
	1987	5406	17	33	18	468	6	350	1491	944	239	37	2	58	1389	40
	3774	5500	29	130	44	499	400	550	2300	5262	304	47	18	73	2918	45
Inundation level (m)	Frequency															
0.00	926	904	936	923	920	927	936	924	927	953	919	936	919	918	936	927
0.50	73	95	64	77	79	73	64	75	73	47	80	64	81	81	64	73
1.00	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inundation level (m)	Normalized Social Risk															
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table G.2 Required time to reach the safe altitude

	Larnaca City Centre	Larnaka Airport	Paphos International Airport	Alexandria City Centre	Alexandria Airport	Alexandria Oil Refinery	Abu Qir Industrial Zone	Abu Qir Port	Al-Arish City Centre	Cairo Agricultural Area
Inundation level (m)	Distance to the next altitude									
0 to 0.5	0.00	0.01	0.01	0.04	1.17	1.17	0.01	0.03	0.02	7.25
0 to 1	0.01	0.03	0.02	0.08	2.34	2.34	0.02	0.06	0.03	14.49
1 to 2	0.04	0.11	0.05	0.17	2.46	2.46	0.26	0.12	0.08	31.01
2 to 3	0.08	0.75	0.08	0.37	2.54	2.54	1.52	0.16	0.14	39.10
3 to 4	0.12	2.18	0.11	0.26	2.65	2.65	1.56	0.17	0.18	44.58
4 to 5	0.18	2.20	0.14	0.30	2.76	2.76	1.60	0.19	0.22	57.22
5 to 6	0.62	2.30	0.18	0.34	2.86	2.86	1.61	0.21	0.33	61.40
Inundation level (m)	Required time to reach the next altitude (A person can walk 5km/h)									
0 to 0.5	0.0	0.2	0.1	0.5	14.0	14.0	0.1	0.4	0.2	86.9
0 to 1	0.1	0.3	0.2	1.0	28.1	28.1	0.2	0.8	0.4	173.9
1 to 2	0.5	1.4	0.6	2.0	29.5	29.5	3.1	1.5	0.9	372.1
2 to 3	0.9	9.0	1.0	4.5	30.5	30.5	18.2	1.9	1.6	469.2
3 to 4	1.4	26.2	1.3	3.1	31.8	31.8	18.7	2.0	2.1	535.0
4 to 5	2.1	26.4	1.7	3.6	33.1	33.1	19.2	2.2	2.6	686.6
5 to 6	7.5	27.6	2.1	4.1	34.3	34.3	19.3	2.5	3.9	736.8
Inundation level (m)	Frequency									
0.5	82	92	95	91	95	95	95	95	68	88
1.0	1	0	1	1	1	1	1	1	0	1
2.0	0	0	1	0	0	0	0	0	1	0
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Maximum required time (t_R) to reach the safe area (min)	0	0	1	1	**28**	**28**	0	1	0	**174**

Table G.2 Required time to reach the safe altitude (continued)

bb

	Mersa Matruh City Centre	Port Said City Centre	Port Said Port	Crete Summer Villages	Heraklion City Centre	Beirut City Centre	Lebanon Summer Villages	Tripoli City Centre	Beirut Airport	Marina Dbayeh
Inundation level (m)	Distance to the next altitude									
0 to 0.5	0.01	0.03	0.03	0.01	0.01	0.01	0.01	0.00	0.01	0.11
0 to 1	0.01	0.06	0.06	0.03	0.01	0.01	0.02	0.01	0.03	0.22
1 to 2	0.03	0.14	0.14	0.18	0.05	0.02	0.05	0.47	0.04	0.39
2 to 3	0.04	0.19	0.19	0.22	0.08	0.03	0.07	0.54	0.06	0.41
3 to 4	0.05	0.27	0.27	0.42	0.12	0.04	0.09	0.92	0.08	0.43
4 to 5	0.07	0.38	0.38	0.49	0.21	0.06	0.11	0.95	0.39	0.44
5 to 6	0.09	0.60	0.60	0.56	0.25	0.08	0.12	0.99	0.40	0.46
Inundation level (m)	Required time to reach the next altitude (A person can walk 5km/h)									
0 to 0.5	0.1	0.4	0.4	0.2	0.1	0.1	0.1	0.0	0.2	1.3
0 to 1	0.1	0.7	0.7	0.3	0.2	0.1	0.3	0.1	0.3	2.6
1 to 2	0.3	1.7	1.7	2.1	0.6	0.3	0.6	5.6	0.5	4.7
2 to 3	0.5	2.3	2.3	2.6	0.9	0.4	0.9	6.5	0.7	4.9
3 to 4	0.6	3.2	3.2	5.1	1.5	0.5	1.1	11.0	0.9	5.1
4 to 5	0.8	4.6	4.6	5.8	2.5	0.7	1.3	11.4	4.6	5.3
5 to 6	1.1	7.2	7.2	6.7	3.0	0.9	1.4	11.8	4.8	5.5
Inundation level (m)	Frequency									
0.5	89	77	81	76	72	77	72	70	81	81
1.0	1	1	1	3	3	0	0	0	0	0
2.0	0	0	0	2	1	0	0	0	0	0
3.0	0	0	0	0	1	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Maximum required time (t_R) to reach the safe area (min)	0	1	1	2	1	0	0	0	0	1

Table G.2 Required time to reach the safe altitude (continued)

	Haifa City Centre	Nahariya City Centre	Tel Aviv City Centre	Haifa Port&Industrial Zone	Herzliya Marina	Tartus City Centre	Tartus Summer Villages	Latakia Port	Tartus Port	Tartus Agricultural Area
Inundation level (m)	Distance to the next altitude									
0 to 0.5	0.04	0.01	0.05	0.16	0.03	0.01	0.01	0.02	0.01	0.02
0 to 1	0.09	0.02	0.11	0.31	0.06	0.01	0.01	0.05	0.03	0.03
1 to 2	0.11	0.06	0.15	0.35	0.12	0.04	0.03	0.12	0.15	0.90
2 to 3	0.17	0.09	0.17	0.45	0.17	0.07	0.04	0.24	0.23	1.35
3 to 4	0.31	0.12	0.48	0.61	0.34	0.09	0.06	0.52	0.91	1.74
4 to 5	0.52	0.16	0.58	0.73	0.37	0.11	0.10	0.77	1.25	2.02
5 to 6	0.80	0.21	0.62	0.93	0.41	0.13	0.26	0.80	1.29	2.16
Inundation level (m)	Required time to reach the next altitude (A person can walk 5km/h)									
0 to 0.5	0.5	0.1	0.7	1.9	0.4	0.1	0.1	0.3	0.2	0.2
0 to 1	1.0	0.2	1.3	3.7	0.7	0.1	0.1	0.6	0.3	0.4
1 to 2	1.3	0.7	1.7	4.1	1.4	0.5	0.3	1.5	1.8	10.8
2 to 3	2.0	1.0	2.0	5.4	2.1	0.8	0.5	2.9	2.8	16.2
3 to 4	3.7	1.5	5.8	7.3	4.1	1.1	0.7	6.2	10.9	20.9
4 to 5	6.2	2.0	7.0	8.7	4.5	1.3	1.2	9.2	15.0	24.2
5 to 6	9.6	2.5	7.4	11.2	4.9	1.5	3.1	9.6	15.5	25.9
Inundation level (m)	Frequency									
0.5	76	75	70	80	74	69	69	71	73	73
1.0	1	1	1	1	1	0	0	0	0	0
2.0	0	0	0	0	0	0	0	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Maximum required time (t_R) to reach the safe area (min)	1	0	1	4	1	0	0	0	0	0

Table G.2 Required time to reach the safe altitude (continued)

	Akdeniz Summer Villages	Alanya Coastal District	Antalya Konyaalti	Belek Summer Villages	Erdemli City Centre	Fethiye City Centre	Finike City Centre	Iskenderun City Centre	Kazanlı City Centre	Kemer City Centre
Inundation level (m)	Distance to the next altitude									
0 to 0.5	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.08	0.00
0 to 1	0.02	0.05	0.02	0.01	0.02	0.01	0.01	0.02	0.15	0.00
1 to 2	0.05	0.11	0.05	0.06	0.05	0.08	0.04	0.04	0.22	0.03
2 to 3	0.06	0.14	0.10	0.08	0.08	0.11	0.06	0.07	0.60	0.05
3 to 4	0.11	0.17	0.12	0.11	0.11	0.28	0.08	0.09	0.99	0.07
4 to 5	0.31	0.50	0.15	0.16	0.15	0.31	0.15	0.12	1.05	0.10
5 to 6	0.45	0.54	0.21	0.19	0.20	0.34	0.55	0.20	1.38	0.21
Inundation level (m)	Required time to reach the next altitude (A person can walk 5km/h)									
0 to 0.5	0.1	0.3	0.1	0.0	0.1	0.1	0.1	0.1	0.9	0.0
0 to 1	0.2	0.6	0.2	0.1	0.2	0.1	0.1	0.2	1.8	0.0
1 to 2	0.6	1.3	0.6	0.7	0.6	1.0	0.5	0.5	2.6	0.3
2 to 3	0.7	1.7	1.2	1.0	1.0	1.4	0.7	0.8	7.2	0.6
3 to 4	1.3	2.1	1.5	1.3	1.4	3.3	0.9	1.1	11.8	0.8
4 to 5	3.7	6.0	1.8	2.0	1.8	3.8	1.8	1.5	12.6	1.2
5 to 6	5.4	6.4	2.5	2.3	2.4	4.1	6.6	2.4	16.6	2.5
Inundation level (m)	Frequency									
0.5	58	77	74	75	62	82	82	44	60	77
1.0	1	0	1	1	1	3	2	0	0	0
2.0	0	1	0	0	0	3	1	0	0	0
3.0	0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	1	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0	0
Maximum required time (t_R) to reach the safe area (min)	0	1	0	0	0	3	1	0	1	0

Table G.2 Required time to reach the safe altitude (continued)

	Manavgat Coastal District	Susanoglu Summer Villages	Turkler Summer Villages	Dalaman Airport	Port Akdeniz	Cukurova Agricultural Area	Dalaman Agricultural Area	Samandag Agricultural Area	Akkuyu NPP Construction Site
Inundation level (m)	Distance to the next altitude								
0 to 0.5	0.01	0.00	0.00	0.06	0.01	1.54	0.03	0.22	0.07
0 to 1	0.02	0.01	0.01	0.13	0.02	3.07	0.07	0.43	0.14
1 to 2	0.08	0.02	0.07	0.80	0.12	2.59	0.19	0.54	0.16
2 to 3	0.09	0.06	0.09	0.87	0.16	4.79	0.27	1.21	0.18
3 to 4	0.12	0.08	0.12	0.96	0.20	7.83	1.70	1.75	0.20
4 to 5	0.16	0.10	**0.17**	3.10	0.33	11.84	1.85	1.99	0.22
5 to 6	1.70	0.11	0.40	3.30	0.47	12.61	1.90	2.21	0.24
Inundation level (m)	Required time to reach the next altitude (A person can walk 5km/h)								
0 to 0.5	0.1	0.0	0.0	0.8	0.1	18.4	0.4	2.6	0.8
0 to 1	0.3	0.1	0.1	1.5	0.2	36.8	0.8	5.2	1.6
1 to 2	0.9	0.3	0.8	9.6	1.4	31.1	2.3	6.5	1.9
2 to 3	1.1	0.8	1.1	10.5	1.9	57.5	3.2	14.5	2.2
3 to 4	1.4	1.0	1.4	11.5	2.4	94.0	20.4	20.9	2.4
4 to 5	1.9	1.1	2.0	37.2	4.0	142.1	22.2	23.8	2.7
5 to 6	20.4	1.3	4.8	39.6	5.6	151.3	22.8	26.5	2.9
Inundation level (m)	Frequency								
0.5	78	65	81	87	79	67	87	67	73
1.0	1	0	1	4	1	0	4	1	1
2.0	0	0	0	2	0	0	2	0	0
3.0	0	0	0	0	0	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0
6.0	0	0	0	0	0	0	0	0	0
Maximum required time (t_R) to reach the safe area (min)	0	0	0	**10**	0	**18**	2	5	2

Table G.3 Selected TEWS locations and risky earthquake epicenters in the study area

TEWS Number	TEWS coordinates (Latitude-Longitude)	Source Region (SR)	Source location (Latitude-Longitude)
1	34.284-27.263	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07
2	35.453-28.206	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07
3	34.422-26.524	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07
4	35.395-26.154	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07
5	35.056-31.384	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07
6	33.194-30.155	SR1	34.94-26.12
		SR2	36.83-27.82
		SR3	35.04-27.23
		SR4	36.88-27.70
		SR5	35.04-32.27
		SR6	35.04-27.90
		SR7	37.76-26.70
		SR8	34.86-26.07

Table G.4 ETA from earthquake epicenter to TEWS and to EwHSR

TEWS Number	Source Region (SR)	ETA-TEWS (min)	ETA-EaR (min)				
			Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	32	208	208	229	180	52
	SR2	164	141	141	224	294	169
	SR3	2	127	127	66	167	27
	SR4	136	148	148	180	215	127
	SR5	43	61	61	51	111	44
	SR6	12	78	78	111	215	18
	SR7	75	144	144	134	184	236
	SR8	11	62	62	73	135	44
2	SR1	37	208	208	229	180	52
	SR2	3	141	141	224	294	169
	SR3	20	127	127	66	167	27
	SR4	119	148	148	180	215	127
	SR5	86	61	61	51	111	44
	SR6	0	78	78	111	215	18
	SR7	158	144	144	134	184	236
	SR8	26	62	62	73	135	44
3	SR1	35	208	208	229	180	52
	SR2	158	141	141	224	294	169
	SR3	0	127	127	66	167	27
	SR4	137	148	148	180	215	127
	SR5	50	61	61	51	111	44
	SR6	17	78	78	111	215	18
	SR7	72	144	144	134	184	236
	SR8	4	62	62	73	135	44
4	SR1	56	208	208	229	180	52
	SR2	68	141	141	224	294	169
	SR3	19	127	127	66	167	27
	SR4	120	148	148	180	215	127
	SR5	161	61	61	51	111	44
	SR6	26	78	78	111	215	18
	SR7	64	144	144	134	184	236
	SR8	0	62	62	73	135	44
5	SR1	113	208	208	229	180	52
	SR2	103	141	141	224	294	169
	SR3	111	127	127	66	167	27
	SR4	169	148	148	180	215	127
	SR5	8	61	61	51	111	44
	SR6	144	78	78	111	215	18
	SR7	225	144	144	134	184	236
	SR8	54	62	62	73	135	44
6	SR1	139	208	208	229	180	52
	SR2	133	141	141	224	294	169
	SR3	78	127	127	66	167	27
	SR4	174	148	148	180	215	127
	SR5	28	61	61	51	111	44
	SR6	42	78	78	62	215	18
	SR7	115	144	144	134	184	236
	SR8	42	62	62	73	135	44

Table G.5 Required time to reach the safe altitude for each EwHSR

TEWS Number	Source Region (SR)	Required time to reach the safe altitude (t_R) (min)				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					
2	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					
3	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					
4	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					
5	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					
6	SR1	28	28	174	18	10
	SR2					
	SR3					
	SR4					
	SR5					
	SR6					
	SR7					
	SR8					

Table G.6 Remaining time to move to safe altitude for each EwHSR

TEWS Number	Source Region (SR)	Remaining time to move to safe altitude after tsunami warning (t_A) (min)				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	176	176	197	148	20
	SR2	0	0	60	130	5
	SR3	125	125	64	165	25
	SR4	12	12	44	79	0
	SR5	18	18	8	68	1
	SR6	66	66	99	203	6
	SR7	69	69	59	109	161
	SR8	51	51	62	124	33
2	SR1	171	171	192	143	15
	SR2	138	138	221	291	166
	SR3	107	107	46	147	7
	SR4	29	29	61	96	8
	SR5	0	0	0	25	0
	SR6	78	78	111	215	18
	SR7	0	0	0	26	78
	SR8	36	36	47	109	18
3	SR1	173	173	194	145	17
	SR2	0	0	66	136	11
	SR3	127	127	66	167	27
	SR4	11	11	43	78	0
	SR5	11	11	1	61	0
	SR6	61	61	94	198	1
	SR7	72	72	62	112	164
	SR8	58	58	69	131	40
4	SR1	152	152	173	124	0
	SR2	73	73	156	226	101
	SR3	108	108	47	148	8
	SR4	28	28	60	95	7
	SR5	0	0	0	0	0
	SR6	52	52	85	189	0
	SR7	80	80	70	120	172
	SR8	62	62	73	135	44
5	SR1	95	95	116	67	0
	SR2	38	38	121	191	66
	SR3	16	16	0	56	0
	SR4	0	0	11	46	0
	SR5	53	53	43	103	36
	SR6	0	0	0	71	0
	SR7	0	0	0	0	11
	SR8	8	8	19	81	0
6	SR1	69	69	90	41	0
	SR2	8	8	91	161	36
	SR3	49	49	0	89	0
	SR4	0	0	6	41	0
	SR5	33	33	23	83	16
	SR6	36	36	20	173	0
	SR7	29	29	19	69	121
	SR8	20	20	31	93	2

Table G.7 Risk reduction coefficients after TEWS installation for each EwHSR

TEWS Number	Source Region (SR)	Risk reduction coefficient (CR) after TEWS installation				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	1.00	1.00	1.00	1.00	1.00
	SR2	0.00	0.00	0.34	1.00	0.50
	SR3	1.00	1.00	0.37	1.00	1.00
	SR4	0.43	0.43	0.25	1.00	0.00
	SR5	0.64	0.64	0.05	1.00	0.10
	SR6	1.00	1.00	0.57	1.00	0.60
	SR7	1.00	1.00	0.34	1.00	1.00
	SR8	1.00	1.00	0.36	1.00	1.00
2	SR1	1.00	1.00	1.00	1.00	1.00
	SR2	1.00	1.00	1.00	1.00	1.00
	SR3	1.00	1.00	0.26	1.00	0.70
	SR4	1.00	1.00	0.35	1.00	0.80
	SR5	0.00	0.00	0.00	1.00	0.00
	SR6	1.00	1.00	0.64	1.00	1.00
	SR7	0.00	0.00	0.00	1.00	1.00
	SR8	1.00	1.00	0.27	1.00	1.00
3	SR1	1.00	1.00	1.00	1.00	1.00
	SR2	0.00	0.00	0.38	1.00	1.00
	SR3	1.00	1.00	0.38	1.00	1.00
	SR4	0.39	0.39	0.25	1.00	0.00
	SR5	0.39	0.39	0.01	1.00	0.00
	SR6	1.00	1.00	0.54	1.00	0.10
	SR7	1.00	1.00	0.36	1.00	1.00
	SR8	1.00	1.00	0.40	1.00	1.00
4	SR1	1.00	1.00	0.99	1.00	0.00
	SR2	1.00	1.00	0.90	1.00	1.00
	SR3	1.00	1.00	0.27	1.00	0.80
	SR4	1.00	1.00	0.34	1.00	0.70
	SR5	0.00	0.00	0.00	0.00	0.00
	SR6	1.00	1.00	0.49	1.00	0.00
	SR7	1.00	1.00	0.40	1.00	1.00
	SR8	1.00	1.00	0.42	1.00	1.00
5	SR1	1.00	1.00	0.67	1.00	0.00
	SR2	1.00	1.00	0.70	1.00	1.00
	SR3	0.57	0.57	0.00	1.00	0.00
	SR4	0.00	0.00	0.06	1.00	0.00
	SR5	1.00	1.00	0.25	1.00	1.00
	SR6	0.00	0.00	0.00	1.00	0.00
	SR7	0.00	0.00	0.00	0.00	1.00
	SR8	0.29	0.29	0.11	1.00	0.00
6	SR1	1.00	1.00	0.52	1.00	0.00
	SR2	0.29	0.29	0.52	1.00	1.00
	SR3	1.00	1.00	0.00	1.00	0.00
	SR4	0.00	0.00	0.03	1.00	0.00
	SR5	1.00	1.00	0.13	1.00	1.00
	SR6	1.00	1.00	0.11	1.00	0.00
	SR7	1.00	1.00	0.11	1.00	1.00
	SR8	0.71	0.71	0.18	1.00	0.20

Table G.8 Social risk calculation for each EwHSR with and without TEWS deployment

TEWS Number	Source Region (SR)	Social Risk without TEWS					Social Risk with TEWS				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	144	390	199971	842	92	0	0	0	0	0
	SR2						144	390	131015	0	46
	SR3						0	0	126418	0	0
	SR4						82	223	149404	0	92
	SR5						51	139	190777	0	83
	SR6						0	0	86194	0	37
	SR7						0	0	132165	0	0
	SR8						0	0	128717	0	0
2	SR1	144	390	199971	842	92	0	0	0	0	0
	SR2						0	0	0	0	0
	SR3						0	0	147105	0	28
	SR4						0	0	129866	0	18
	SR5						144	390	199971	0	92
	SR6						0	0	72403	0	0
	SR7						144	390	199971	0	0
	SR8						0	0	145956	0	0
3	SR1	144	390	199971	842	92	0	0	0	0	0
	SR2						144	390	124120	0	0
	SR3						0	0	124120	0	0
	SR4						87	237	150553	0	92
	SR5						87	237	198822	0	92
	SR6						0	0	91941	0	83
	SR7						0	0	128717	0	0
	SR8						0	0	120672	0	0
4	SR1	144	390	199971	842	92	0	0	1149	0	92
	SR2						0	0	20687	0	0
	SR3						0	0	145956	0	18
	SR4						0	0	131015	0	28
	SR5						144	390	199971	842	92
	SR6						0	0	102284	0	92
	SR7						0	0	119523	0	0
	SR8						0	0	116075	0	0
5	SR1	144	390	199971	842	92	0	0	66657	0	92
	SR2						0	0	60911	0	0
	SR3						62	167	199971	0	92
	SR4						144	390	187329	0	92
	SR5						0	0	150553	0	0
	SR6						144	390	199971	0	92
	SR7						144	390	199971	842	0
	SR8						103	279	178135	0	92
6	SR1	144	390	199971	842	92	0	0	96538	0	92
	SR2						103	279	95388	0	0
	SR3						0	0	199971	0	92
	SR4						144	390	193075	0	92
	SR5						0	0	173538	0	0
	SR6						0	0	176986	0	92
	SR7						0	0	178135	0	0
	SR8						41	111	164344	0	74

Table G.9 Risk reduction percentages of EwHSR according to risky earthquakes

TEWS Number	Source Region (SR)	Risk Reduction %				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
1	SR1	100	100	100	100	100
	SR2	0	0	34	100	50
	SR3	100	100	37	100	100
	SR4	43	43	25	100	0
	SR5	64	64	5	100	10
	SR6	100	100	57	100	60
	SR7	100	100	34	100	100
	SR8	100	100	36	100	100
2	SR1	100	100	100	100	100
	SR2	100	100	100	100	100
	SR3	100	100	26	100	70
	SR4	100	100	35	100	80
	SR5	0	0	0	100	0
	SR6	100	100	64	100	100
	SR7	0	0	0	100	100
	SR8	100	100	27	100	100
3	SR1	100	100	100	100	100
	SR2	0	0	38	100	100
	SR3	100	100	38	100	100
	SR4	39	39	25	100	0
	SR5	39	39	1	100	0
	SR6	100	100	54	100	10
	SR7	100	100	36	100	100
	SR8	100	100	40	100	100
4	SR1	100	100	99	100	0
	SR2	100	100	90	100	100
	SR3	100	100	27	100	80
	SR4	100	100	34	100	70
	SR5	0	0	0	0	0
	SR6	100	100	49	100	0
	SR7	100	100	40	100	100
	SR8	100	100	42	100	100
5	SR1	100	100	67	100	0
	SR2	100	100	70	100	100
	SR3	57	57	0	100	0
	SR4	0	0	6	100	0
	SR5	100	100	25	100	100
	SR6	0	0	0	100	0
	SR7	0	0	0	0	100
	SR8	29	29	11	100	0
6	SR1	100	100	52	100	0
	SR2	29	29	52	100	100
	SR3	100	100	0	100	0
	SR4	0	0	3	100	0
	SR5	100	100	13	100	100
	SR6	100	100	11	100	0
	SR7	100	100	11	100	100
	SR8	71	71	18	100	20

Table G.10 Overall risk reduction percentage by averaging all risks from EwHSR and risky earthquakes

TEWS Number	Source Region (SR)	Overall Risk Reduction %
1	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	72
2	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	75
3	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	70
4	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	73
5	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	49
6	SR1 SR2 SR3 SR4 SR5 SR6 SR7 SR8	62

APPENDIX H - SOCIAL RISK REDUCTION FOR HISTORICAL EARTHQUAKES

In this appendix social risk reduction values for 365AD Crete, 1222 Paphos, and 1303 Crete earthquakes are given. Locations of the historical earthquakes and TEWSs in the study area, Detailed information such as ETAs from source to TEWS and to EwHSR, remaining time to move to safe altitude after tsunami warning and required time to reach the safe altitude, risk reduction coefficients after TEWS positioning, social risk calculations with and without application of early warning, risk reduction percentages according to EwHSR and overall risk reduction by averaging the risk of all EwHSR are given in Tables H.1 to H.6, respectively .

Table H.1 Locations of the historical earthquakes and TEWSs in the study area

Source Region (SR)	Source location (Latitude-Longitude)	TEWS Number	TEWS coordinates (Latitude-Longitude)
365	35.00-23.00	1	34.284-27.263
		2	35.453-28.206
		3	34.422-26.524
		4	35.395-26.154
		5	35.056-31.384
		6	33.194-30.155
1222	34.70-32.60	1	34.284-27.263
		2	35.453-28.206
		3	34.422-26.524
		4	35.395-26.154
		5	35.056-31.384
		6	33.194-30.155
1303	35.00-27.00	1	34.284-27.263
		2	35.453-28.206
		3	34.422-26.524
		4	35.395-26.154
		5	35.056-31.384
		6	33.194-30.155

Table H.2 ETAs from source to TEWS and to EwHSR

Source Region (SR)	TEWS Number	ETA-TEWS (min)	ETA-EaR (min)				
			Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
365	1	38	91	91	98	No Risk	125
	2	0					
	3	33					
	4	160					
	5	0					
	6	0					
1222	1	49	62	62	50	75	50
	2	42					
	3	57					
	4	71					
	5	11					
	6	27					
1303	1	14	74	74	108	204	46
	2	111					
	3	7					
	4	85					
	5	55					
	6	75					

Table H.3 Remaining time to move to safe altitude after tsunami warning and required time to reach the safe altitude

Source Region (SR)	TEWS Number	Remaining time to move to safe altitude after tsunami warning (t_A) (min)					Required time to reach the safe altitude (t_R) (min)				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
365	1	53	53	60	No Risk	87	28	28	174	18	10
	2	91	91	98	No Risk	125					
	3	58	58	65	No Risk	92					
	4	0	0	0	No Risk	0					
	5	91	91	98	No Risk	125					
	6	91	91	98	No Risk	125					
1222	1	13	13	1	26	1	28	28	174	18	10
	2	20	20	8	33	8					
	3	5	5	0	18	0					
	4	0	0	0	4	0					
	5	51	51	39	64	39					
	6	35	35	23	48	23					
1303	1	60	60	94	190	32	28	28	174	18	10
	2	0	0	0	93	0					
	3	67	67	101	197	39					
	4	0	0	23	119	0					
	5	19	19	53	149	0					
	6	0	0	33	129	0					

Table H.4 Risk reduction coefficient for each EwHSR after TEWS positioning

Source Region (SR)	TEWS Number	Risk Coefficient (CR) after TEWS installation				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
365	1	1.00	1.00	0.34	No Risk	1.00
	2	1.00	1.00	0.56	No Risk	1.00
	3	1.00	1.00	0.37	No Risk	1.00
	4	0.00	0.00	0.00	No Risk	0.00
	5	1.00	1.00	0.56	No Risk	1.00
	6	1.00	1.00	0.56	No Risk	1.00
1222	1	0.46	0.46	0.01	1.00	0.10
	2	0.71	0.71	0.05	1.00	0.80
	3	0.18	0.18	0.00	1.00	0.00
	4	0.00	0.00	0.00	0.22	0.00
	5	1.00	1.00	0.22	1.00	1.00
	6	1.00	1.00	0.13	1.00	1.00
1303	1	1.00	1.00	0.54	1.00	1.00
	2	0.00	0.00	0.00	1.00	0.00
	3	1.00	1.00	0.58	1.00	1.00
	4	0.00	0.00	0.13	1.00	0.00
	5	0.68	0.68	0.30	1.00	0.00
	6	0.00	0.00	0.19	1.00	0.00

Table H.5 Social risk calculation for each EwHSR with and without application of early warning

Source Region (SR)	TEWS Number	Social Risk without TEWS					Social Risk with TEWS				
		Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport
365	1	1487	4024	2221900	No Risk	878	0	0	1455728	No Risk	0
	2						0	0	970485	No Risk	0
	3						0	0	1391880	No Risk	0
	4						1487	4024	2221900	No Risk	878
	5						0	0	970485	No Risk	0
	6						0	0	970485	No Risk	0
1222	1	2996	8553	10826622	25134	1755	1605	4582	10764400	0	1580
	2						856	2444	10328846	0	351
	3						2461	7026	10826622	0	1755
	4						2996	8553	10826622	19549	1755
	5						0	0	8399965	0	0
	6						0	0	9395517	0	0
1303	1	2996	8553	7969133	25134	1755	0	0	3663969	0	0
	2						2996	8553	7969133	0	1755
	3						0	0	3343372	0	0
	4						2996	8553	6915742	0	1755
	5						963	2749	5541753	0	1755
	6						2996	8553	6457746	0	1755

Table H.6 Risk reduction percentages according to EwHSR and overall risk reduction by averaging the risk of all EwHSR

Source Region (SR)	TEWS Number	Risk Reduction % Alexandria Airport	Alexandria Oil Refinery	Cairo Agricultural Area	Cukurova Agricultural Area	Dalaman Airport	Overall Risk Reduction %
365	1	100	100	34	No Risk	100	67
	2	100	100	56	No Risk	100	71
	3	100	100	37	No Risk	100	67
	4	0	0	0	No Risk	0	0
	5	100	100	56	No Risk	100	71
	6	100	100	56	No Risk	100	71
1222	1	46	46	1	100	10	41
	2	71	71	5	100	80	65
	3	18	18	0	100	0	27
	4	0	0	0	22	0	4
	5	100	100	22	100	100	84
	6	100	100	13	100	100	83
1303	1	100	100	54	100	100	91
	2	0	0	0	100	0	20
	3	100	100	58	100	100	92
	4	0	0	13	100	0	23
	5	68	68	30	100	0	53
	6	0	0	19	100	0	24

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PUBLICATIONS

1. Yavuz C,,Yilmaz K. (2017). Estimation of Energy Reduction for Ski Jump Jets. Eurasian Journal of Engineering Sciences and Technology, 1(1), 39-44.
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