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# LIQUEFACT

Assessment and mitigation of Liquefaction potential across Europe: a holistic approach to protect structures/infrastructure for improved resilience to earthquake-induced Liquefaction disasters.

H2020-DRA-2015

GA no. 700748

## DELIVERABLE D2.4

# GIS database of the historical liquefaction occurrences in Europe and European empirical correlations to predict the liquefaction occurrence starting from the main seismological information

| | |
|---|---|
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## GLOSSARY

| Acronym | Description |
|---|---|
| GIS | Geographical Information System |
| Mw | Moment magnitude |
| Ms | Surface-wave magnitude |
| Me | Magnitude derived from the intensity points distribution |
| Repi | Epicentral distance |
| Rhyp | Hypocentral distance |
| Rf | Fault distance |
| $Vs_{30}$ | Average shear-wave velocity in the upper 30 m of subsoil |
| PGA | Peak Ground Acceleration (at free surface) |
| GMPE | Ground motion prediction equation |
| EC8 | Eurocode 8 (2003) |
| Io | Macroseismic intensity |
| MCS | Mercalli-Cancani-Sieberg scale |

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Table 3-4 PGA thresholds for Italy computed through the GMPE by Akkar et al. (2014) and Bindi et al. (2011). Both average values and average values increased by one standard deviation were considered

# 1. INTRODUCTION AND PURPOSE OF THIS DOCUMENT

Work Package 2 (WP2) of LIQUEFACT project deals with the zonation of a territory for liquefaction risk at two very different geographical scales, i.e. the continental scale and the municipal or submunicipal scale.

Within WP2, aim of Task 2.3 is the construction of a GIS-based catalogue of historical liquefaction occurrences in Europe. In this framework, a database containing historical information regarding the liquefaction-related phenomena occurred in Europe, including sand ejects and boils, soil settlements and lateral spreading, ground and structural failures, was developed. To built the catalogue of liquefaction manifestations, a critical bibliographic review was carried out to identify the most suitable sources to be used, such as existing databases for specific areas (e.g. for Italy), studies, reports and tales concerning earthquakes, chronicles and diaries, archival documentation and seismic bulletins. In this research, one of the most important starting points is represented by the earthquake catalogue set up for the European territory within recent research projects (i.e. SHARE "*Seismic Hazard Harmonization in Europe*"). Descriptions of liquefaction manifestations triggered by earthquakes, including, if possible, photos and figures, were gathered from the collected references and used to construct a European database under a GIS environment. Thus, the GIS-based catalogue includes two pieces of information: main seismological features of the seismic events (date, geographic coordinates, magnitude, focal mechanism if known, etc.) and liquefaction site parameters (epicentral distance, type of failure, etc.).

On the basis of the European liquefaction occurrences catalogue, calculation of European regressions to predict liquefaction occurrence was carried out starting from the main seismological information of an earthquake within Task 2.4 of WP2. In particular, new empirical European relationships between earthquake magnitude and distance for liquefaction was computed. The dataset was used to identify, on the basis of statistical analyses, magnitude-distance couple threshold below which liquefaction is unlikely to occur, regardless of the geological site conditions. The new correlations was compared to those obtained from the studies available in literature. In setting up the novel empirical models, an effort was made to take into account the influence of both aleatory and epistemic (i.e. model-based) uncertainty. Furthermore, an attempt to define a peak acceleration threshold for soil liquefaction for Europe was undertaken. The focus is on another single liquefaction triggering factor, the peak ground acceleration (PGA) at the site surface. As a matter of fact, if the maximum acceleration at the site is lower than the acceleration limit, liquefaction should not occur, or is very unlikely, regardless of other seismological and geotechnical conditions.

Aim of this document is to illustrates the activities carried out within Task 2.3 and Task 2.4, delivered as D2.4 titled "*GIS database of the historical liquefaction occurrences in Europe and European empirical correlations to predict the liquefaction occurrence starting from the main seismological information*".

# 2. GIS-BASED CATALOGUE OF MANIFESTATIONS OF EARTHQUAKE-INDUCED LIQUEFACTION IN EUROPE

## 2.1 Building the catalogue of liquefaction cases in Europe

To built the catalogue of liquefaction manifestations, a critical bibliographic review was carried out to identify containing historical information regarding the liquefaction-related phenomena occurred in Europe, including sand ejects and boils, soil settlements and lateral spreading, ground and structural failures. The starting point was the catalogues including historical liquefaction cases available for specific countries or regions in Europe, i.e. the catalogues for Italy, Portugal and the Aegean territory, that were retrieved, reviewed, and updated in this study.

### 2.1.1 Review of the available catalogues for Italy, Portugal and Aegean territory

For the Italian territory, a systematic collection of liquefaction effects, induced by 317 earthquakes occurred in the 1117-1990 period was carried out (Galli and Meloni, 1993; Galli, 2000). The database presented contains indication of liquefaction related to earthquakes that occurred in Italy from 1117 AD to 1990 (Figure 2-1). The seismic event intensity ranged from 5.5 to 11, while several classes, depending on the type of described the magnitude ranged from 4.2 to 7.5 for Ms and from 4.83 to 7.46 for Me.

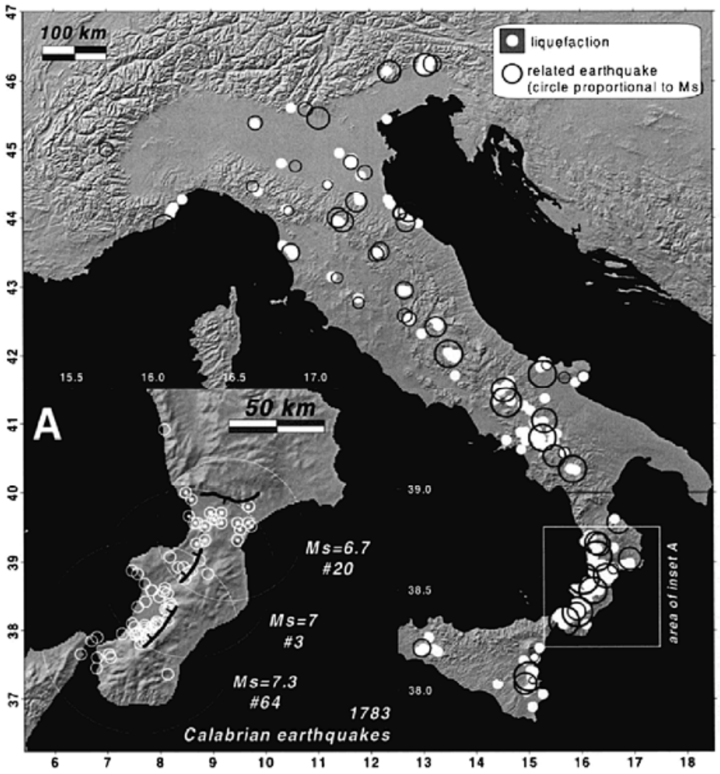


**Figure 2-1 Distribution map of liquefaction cases reported in Galli (2000). Inset A is a particular concerning the 1783 Calabrian earthquakes. Bold lines represent the possibly seismogenetic faults of the three main events (large circles, from south to north: February 5 and 7, and March 28)**

Pirrotta et al. (2007) presents an updated dataset of liquefaction phenomena in central-eastern Sicily, realized through the revision of historical accounts, retrieved from the aforementioned catalogues and through an original research of historical primary sources. The Italian Catalogue of Earthquake-Induced Ground Failures (CEDIT) is a recent updating of the liquefaction occurrence database, to which a few new cases has been added (Fortunato et al., 2012; Martino et al., 2014). The CEDIT database is accessible online at the link http://www.ceri.uniroma1.it/cn/gis.jsp and includes also other types of data, e.g. on landslides, surface faulting, etc.

Jorge (1994) collected data on liquefaction cases occurred in the territory of Portugal. The information includes the magnitude, localization of the epicentre, macroseismic intensity and coordinates of the epicentre. Regrettably, the coordinates where liquefaction occurred as well as the epicentral distances are not reported. Therefore, it was necessary to identify the coordinates of sites where liquefaction was observed starting the description of the location and from the map shown in Figure 2-2.

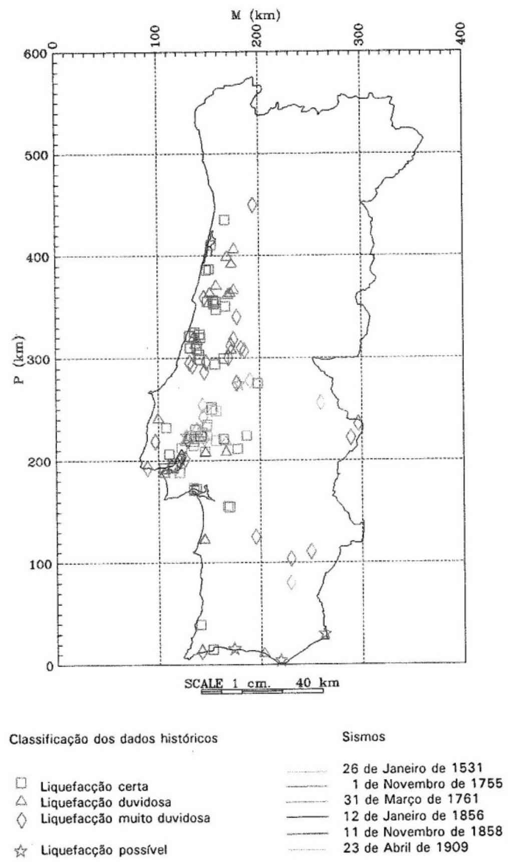


**Figure 2-2 Map showing the distribution of historical liquefaction occurrences in Portugal (Jorge, 1994)**

A map of the distribution of past liquefaction occurrences also exist for the Aegean region provided by the "Database of historical Liquefaction Occurrences", DALO (Papathanassiou and Pavlides, 2009). The DALO database includes liquefaction phenomena triggered by 88 earthquakes occurred in the time window 1509-2003 in Greece and in some areas of Albany, Republic of Macedonia, Republic of Serbia, Montenegro, Bulgaria and Turkey. Figure 2-3 presents the map showing the distribution of historical liquefaction occurrences in the broader Aegean region. It was necessary to identify the sources cited in DALO to get the coordinates of the sites where liquefaction was observed because these coordinates are not provided in DALO.

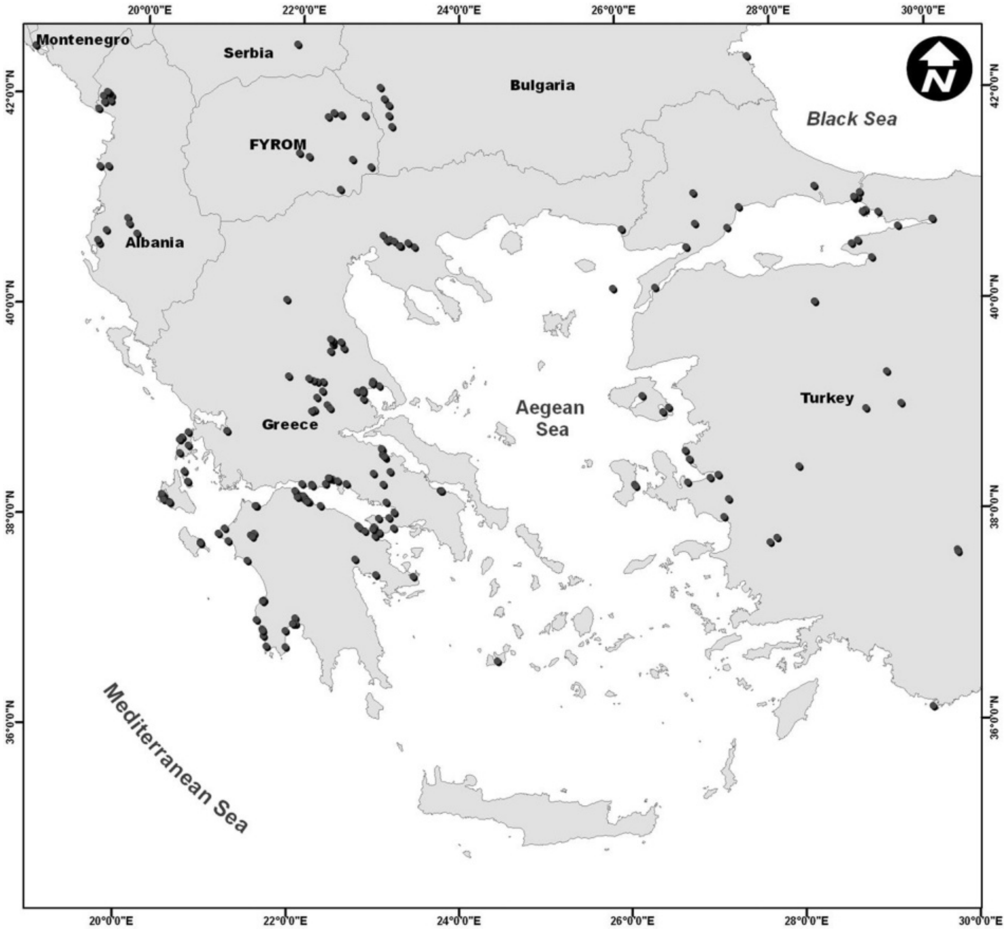


**Figure 2-3 Map showing the distribution of historical liquefaction occurrences in the broader Aegean region (Papathanassiou and Pavlides, 2009)**

### 2.1.2 Collection of liquefaction manifestations occurred in Europe

Descriptions of liquefaction manifestations triggered by earthquakes, including, if possible, photos and figures, were gathered from a large number of references and then used to construct the European database under a GIS environment. Two pieces of information were collected: main seismological features of the seismic events (e.g. date, geographic coordinates, magnitude, focal mechanism if known, etc.) and liquefaction site parameters (e.g epicentral distance, type of failure, etc.). In this research, one of the most important starting points is represented by the earthquake catalogue set up for the European territory within SHARE project (Sesetyan et al., 2014; Locati et al., 2014). For Italy, the most recent version of the Italian catalogue of earthquake (Rovida et al., 2016) was considered.

Data on liquefaction manifestations gathered in this study are briefly presented in Table 2-1, where, for each Country, number of liquefaction cases, number of earthquakes that induced the identified liquefaction cases, and the sources are listed.

**Table 2-1 Data gathered in this study on liquefaction manifestations in Europe: for each Country, number of liquefaction cases, number of earthquakes that induced liquefaction, and the sources for liquefaction cases are listed**

| Country | Num. liquefaction manifestations | Num. earthquakes that induced liquefaction | Sources |
|---|---|---|---|
| Albania | 12 | 5 | Kociu S. (2004), DALO (Papathanassiou 2004) |
| Bulgaria | 16 | 1 | Ambraseys (2001) |
| Croatia | 13 | 3 | Veinovic (2010), Herak (2010) |
| France | 2 | 1 | Barani (2007) |
| FYROM | 1 | 1 | DALO (Papathanassiou 2004) |
| Greece | 183 | 54 | Ambraseys and Jackson (1997), DALO (Papathanassiou 2004), Ambraseys (1990), Papadopoulos (1990), Papathanassiou (2005), Athanasopoulos (1999), EERI (2003), Pavlides et al. (2013), Valkaniotis et al. (2014), Karakostas (2014), Athanasopoulos (1999), Kazantzidu-Firtinidou (2016), Lekkas (2018), Ganas et al. (2015) |
| Hungary | 26 | 5 | Gyori (2015) |
| Italy | 393 | 77 | CEDIT (Martino et al. 2014), Pirrotta et al. (2007), Galli (2000) |
| Montenegro | 15 | 1 | DALO (Papathanassiou 2004), Ishihara (1985), Kociu (2004) |
| Portugal | 76 | 3 | Jorge (1994) |
| Romania | 39 | 5 | Constantin (2010), Gyori (2015), Rogozea (2014), Ishihara (1984) |
| Serbia | 4 | 2 | Veinovic (2006), Dragojević (2010) |
| Spain | 33 | 6 | Valverde-Palacios et al. (2012), Alfaro et al. (2001), Ayala-Carcedo (1995), Silva Barroso et al. (2014) |
| Turkey | 107 | 32 | Tasdemiroglu (1971), DALO (Papathanassiou 2004), Ambraseys (2000), Ambraseys and Finkel (1987), Ambraseys et al.(2000), Lander (1969), Keightley (1975), Williams et al. (1992), Adalier (2000), Kaybali (1997), Wenk, Lacave, Peter (1998), Erdik (1999), Aydan et al. (2004), Ulusay et al. (2004), Ozcebe et al. (2003), Ulusay et al. (2004), Karakas, Coruk (2013), Akin et al. (2013), Selcuk and Aydin (2013), Akyuz et al. (2011), Aydan et al. (1999) |

The database now includes 920 liquefaction manifestations induced by 196 earthquakes. The map in Figure 2-8 shows the distribution of recent and past liquefaction manifestations across Europe. From Figure 2-5 through Figure 2-6 the liquefaction occurrences gathered for specific areas in Europe, i.e. in Italy (Figure 2-5), Eastern Europe (Figure 2-6), and in Western Europe (Figure 2-7) are shown.

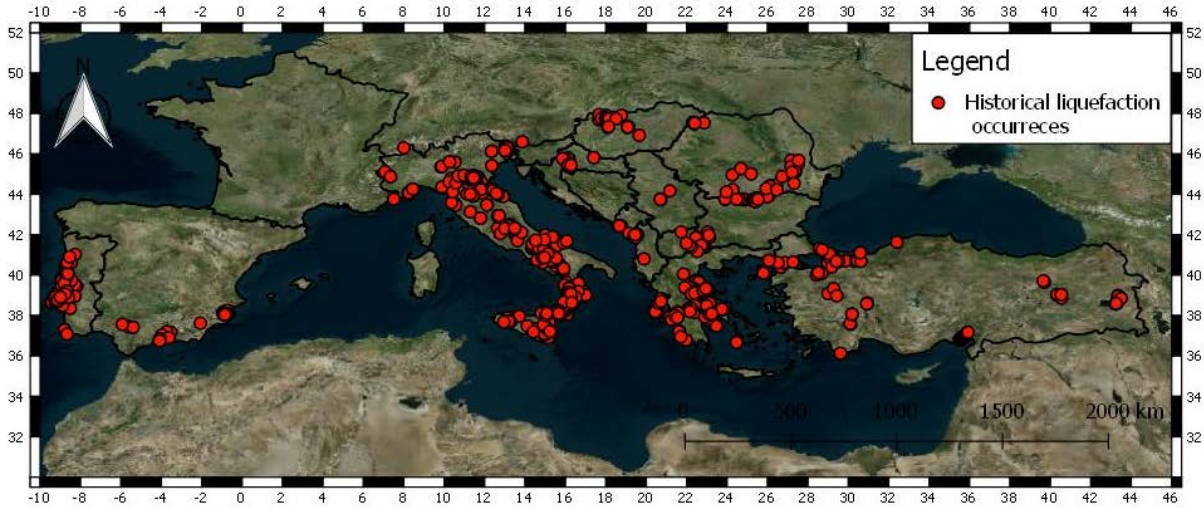


**Figure 2-4 Map showing the distribution of the liquefaction occurrences included in the European catalogue built in this study**

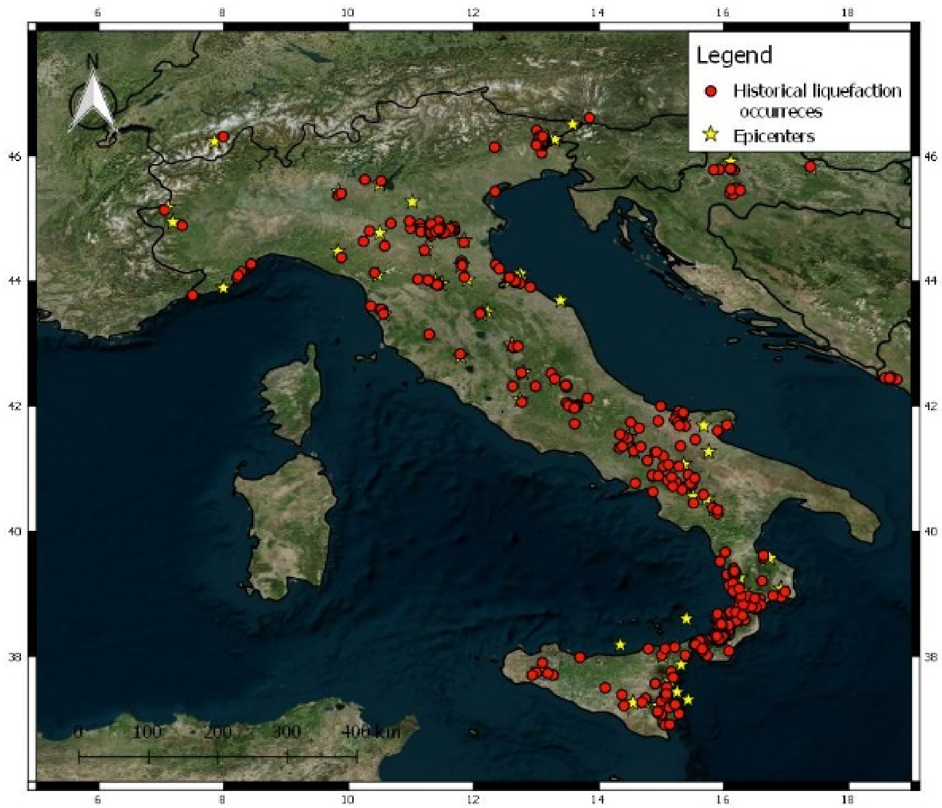


**Figure 2-5 Map showing the distribution of liquefaction occurrences (red dots) induced by earthquakes (yellow stars) occurred in Italy included in the catalogue built in this study**

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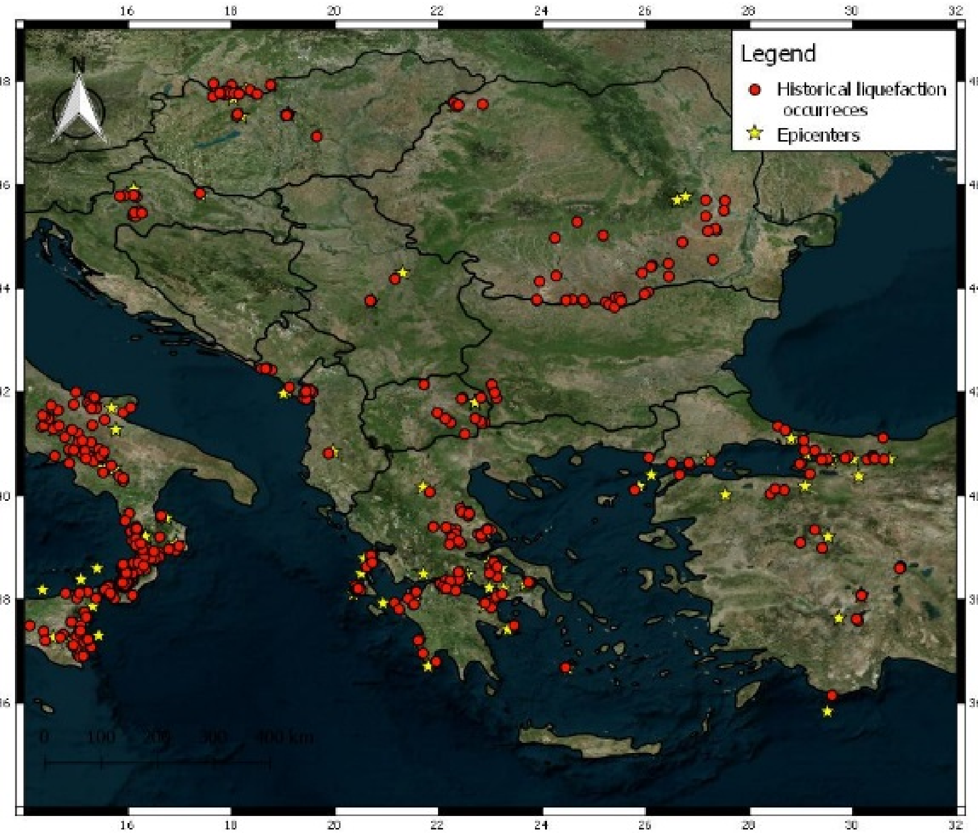
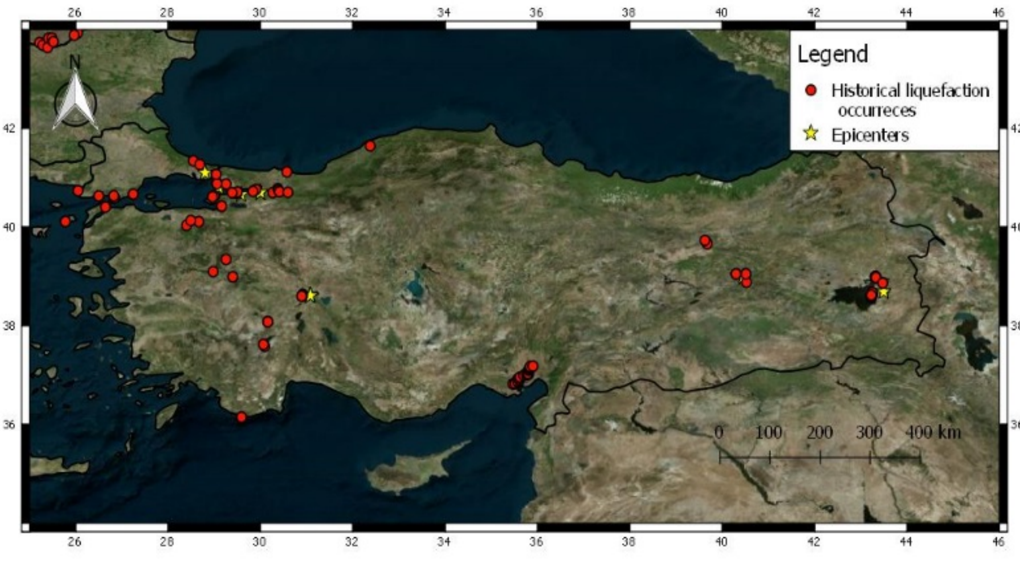



**a)**




**b)**

**Figure 2-6 Map showing the distribution of liquefaction occurrences (red dots) induced by earthquakes (yellow stars) occurred in Eastern Europe included in the catalogue built in this study. The map in b) is a zoom on Turkey**

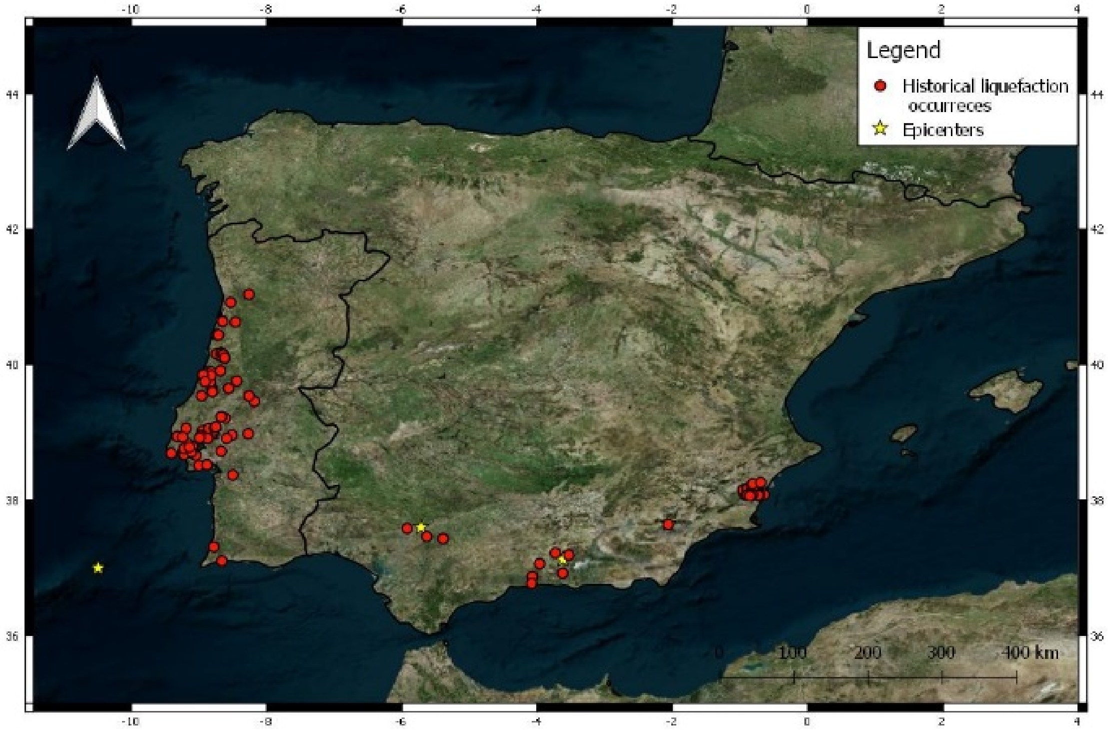



**Figure 2-7 Map showing the distribution of liquefaction occurrences (red dots) induced by earthquakes (yellow stars) occurred in Western Europe included in the catalogue built in this study**

From Figure 2-8 through Figure 2-13 a few examples of liquefaction manifestations collected and integrated in the catalogue built in this study are shown.

**Figure 2-8 Liquefaction in Cephalonia earthquake 2014, Greece (Valkaniotis et al., 2014)**

**Figure 2-9 Liquefaction during Kraljevo earthquake 2010, Serbia (Dragojevic et al., 2011)**

**Figure 2-10 Dug up sand volcano, Kecskemet 1911, Hungary (Gyori, 2015)**

**Figure 2-11 Overturned building due to liquefied foundation, Izmit, Turkey 1999 (Erdik et al., 1999)**

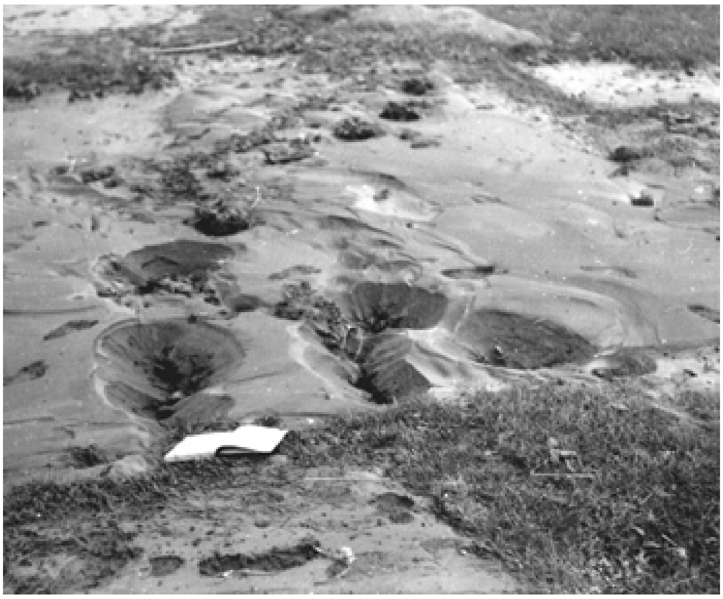


**Figure 2-12 Sand boils in Dajc village, Albania, Montenegro earthquake 1977 (Kociu, 2004)**

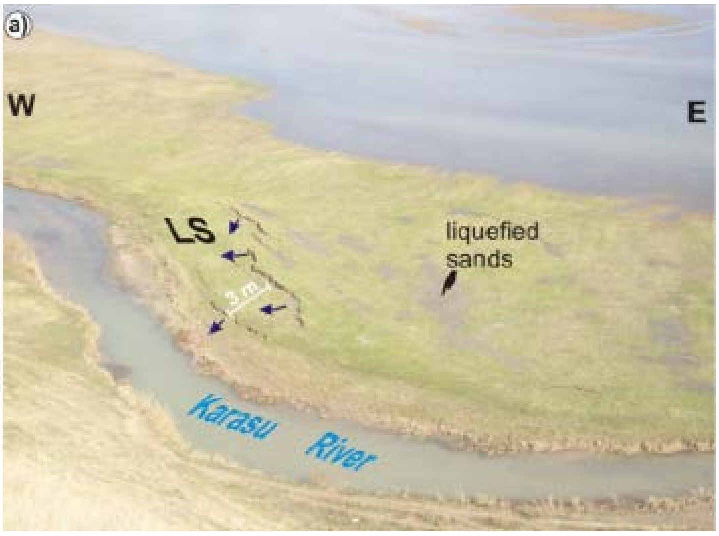



**Figure 2-13 Liquefaction and lateral spreading during 2011 Van earthquake, Turkey (Karakas et al., 2013)**

It is important to point out that the manifestations of liquefaction can appear widespread, as for example during the 2012 seismic sequence occurred in Emilia, Italy (Figure 2-1). In this framework, the definition of single case of liquefaction is a tricky issue and the association of latitude and longitude to a liquefaction case is affected by a significant level of uncertainty. However, it is worth noting that the uncertainty related to the definition of the main seismological features of an earthquake (e.g. magnitude, location, etc.) are affected by at least as much uncertainty.

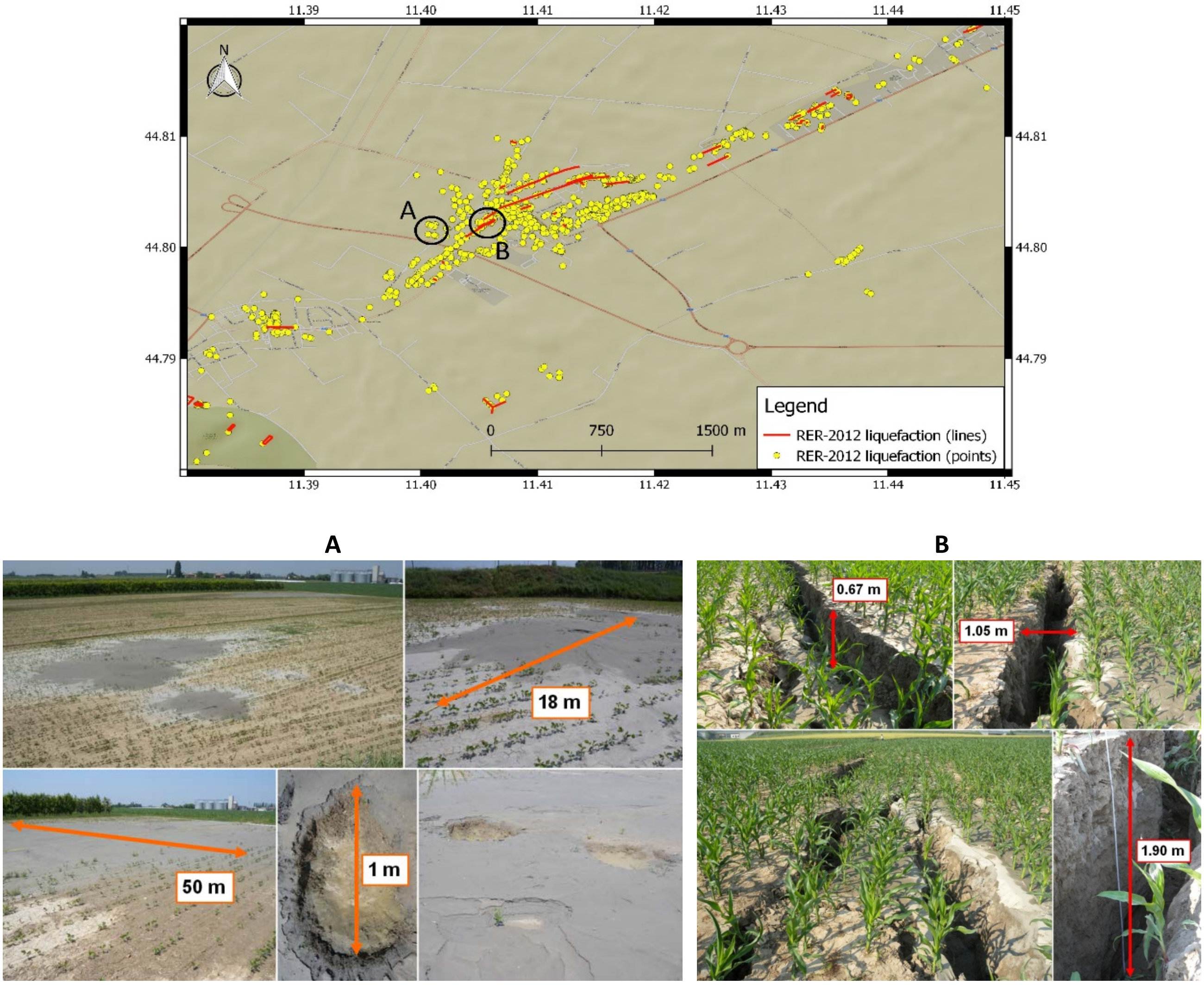



**Figure 2-14 Liquefaction manifestations during 2012 Emilia earthquake, Italy (Bozzoni et al., 2012; Lai et al., 2015) in at San Carlo village: sand boils (A) and lateral spreading (B)**

## 2.1.3 Open issue: the completeness of the catalogue

Finally, this section addresses one of the main open issues in the building the catalogue, i.e. the completeness of the catalogue itself.

Figure 2-15 illustrates the time ranges covered by the catalogue of liquefaction manifestations for each Country for which data were retrieved. Not surprisingly, the longest period is covered by the catalogue for Italy, which spans a period starting in 1117. It appears anomalous that the manifestations of liquefaction phenomenon in many Countries were detected only in the last centuries. This is especially true for Greece.

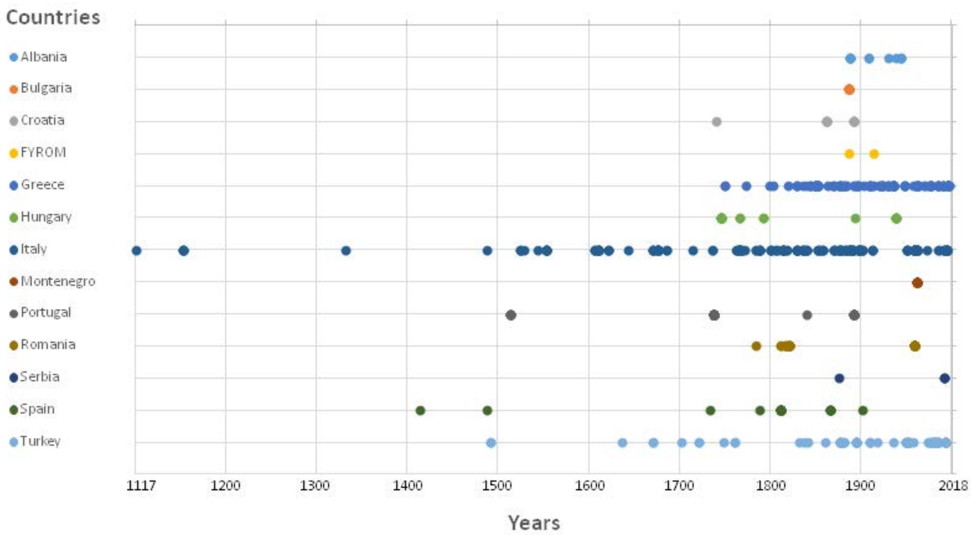



**Figure 2-15 Map showing the distribution of liquefaction manifestations included in the catalogue across Europe. The color of the circles is proportional to the event moment magnitude**

## 2.2 The European catalogue of liquefaction manifestations (Version 1.1)

UNIPV-Eucentre built the first version of the GIS-based catalogue of European manifestations of earthquake-induced soil liquefaction. The structure of the catalogue is illustrated in Section 2.2.1. The version 1.1 of the catalogue includes also the return period associated to each seismic event defined according to the procedure described in Section 2.2.2. The full version of the catalogue is available both in .xlsx file and .shp file (for GIS programs). A compressed version of the catalogue is presented in the Annex.

### 2.2.1 Structure of the GIS-based catalogue

Descriptions of liquefaction manifestations triggered by earthquakes, including, if possible, photos and figures, were gathered and then used to construct a European database under a GIS environment. Figure 2-16 shown an excerpt from the GIS-based catalogue built in this study. The catalogue includes two pieces of information, i.e. the main seismological features of the seismic events and the parameters of site where liquefaction occurred.

Indeed, the section of the catalogue on the main seismological characteristics of the earthquake includes:

- Country where each seismic event occurred;
- date (day, month, and year);
- location of the earthquake;
- coordinates, i.e. latitude and longitude with associated uncertainties;
- magnitude (in terms of different metrics) with associated uncertainties;
- macroseismic intensity (MCS scale);
- depth of the earthquake;
- source/sources adopted for the previously mentioned data on earthquake.

Data concerning sites where liquefaction occurred included in the catalogue are the following:

- location where liquefaction manifestations occurred;
- coordinates, i.e. latitude and longitude with associated uncertainties;
- quality of the location (that will be discussed hereinafter);
- epicentral distance with associated uncertainties
- hypocentral distance with associated uncertainties
- macroseismic intensity (MCS scale);
- type of liquefaction manifestation according to categories in literature (e.g. Galli, 2000);
- source/sources adopted for the previously mentioned data on earthquake.

| | EARTHQUAKES PARAMETERS | | | | | | | | | | | LIQUEFIED SITE PARAMETERS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Country | Date | Location | Latitude | Longitude | M | Type | ,,, | $I_0$ (MCS) | ,,, | Depth [km] | Latitude | Longitude | Liquefied site | ,,, | Repic [km] | Ripo [km] | Liquefaction Type | ,,, |
| ... | | | | | | | | | | | | | | | | | | | |
| 419 | Greece | 1894.04.20 | Martino | 38.6 | 23.209 | 6.77 | Mw | | 10 | | 6 | 38.714 | 23.06 | Livantes | | 18.12 | 19.09 | liquefaction | |
| 420 | Greece | 1894.04.27 | Ag. Konstantinos | 38.716 | 22.959 | 6.91 | Mw | | 10 | | 11 | 38.721 | 23.06 | Livantes | | 8.78 | 14.08 | subsidence | |
| 421 | Greece | 1894.04.27 | Ag. Konstantinos | 38.716 | 22.959 | 6.91 | Mw | | 10 | | 11 | 38.631 | 23.125 | Almyra | | 17.24 | 20.45 | subsidence | |
| 422 | Greece | 1894.04.27 | Ag. Konstantinos | 38.716 | 22.959 | 6.91 | Mw | | 10 | | 11 | 38.499 | 22.973 | Orhomenos | | 24.17 | 26.55 | Unspecified | |
| 423 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.878 | 29.06 | Antigoni | | 43.64 | 46.14 | ground cracks & lateral spreading | |
| 424 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.906 | 29.049 | Proti | | 45.60 | 48.00 | ground cracks | |
| 425 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.871 | 29.258 | Pendik | | 28.02 | 31.79 | ground cracks | |
| 426 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 41.067 | 29.042 | Arnautkoy | | 55.38 | 57.37 | subsidence | |
| 427 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.684 | 29.494 | Hersek | | 8.73 | 17.35 | liquefaction | |
| 428 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.423 | 29.161 | gemlik | | 49.02 | 51.26 | ground cracks & lateral spreading | |
| 429 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.629 | 29.007 | Karakoy | | 47.73 | 50.03 | ground cracks | |
| 430 | Turkey | 1894.07.10 | Izmit | 40.75 | 29.55 | 6.7 | Mw | | 10 | | 15 | 40.614 | 28.964 | Katirli | | 51.69 | 53.82 | ground cracks | |

**Figure 2-16 Excerpt from the GIS-based catalogue built in Liquefact project. The catalogue includes two pieces of information: the main seismological features of the seismic events and the parameters of site where liquefaction occurred**

The identification of the location of sites where liquefaction occurred implies heterogeneous levels of uncertainty. Indeed, the following three main typical conditions was defined:

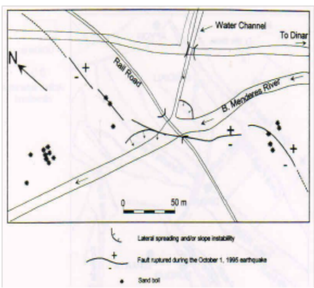
A. Precisely georeferenced
B. Georeferenced from map
C. Location described within text

Examples of the listed conditions are shown in Figure 2-17.

A - Precisely georeferenced

*Cefalonia 2014 quake [Valkaniotis et al. 2014]*

B - Georeferenced from map




*Dinar 1995 quakes [Kayabali,1997]*

C - Location described text

*"Lateral spreading and ground settlement were very pronounced in Northwestern Albania in Shkodra district (Velipoja beach), very close to seaside, with pure Quaternary sandy deposits. Due to such phenomena the ground around Velipoja No. 2 Pump Station's building subsided about 50 cm"*

*Montenegro quakes [Kociu, 2004])*

**Figure 2-17 Examples of the three main typical conditions faced during the identification of the location of sites where liquefaction occurred**

The catalogue now includes 920 liquefaction manifestations. The map in Figure 2-18 shows the distribution of liquefaction occurrences across Europe and the color of the circles is proportional to the event moment magnitude. From the graph in Figure 2-19, it turns out that the largest number of liquefaction manifestations were induced by earthquake of moderate magnitude, i.e. Mw ranging from 6 to 6.5.

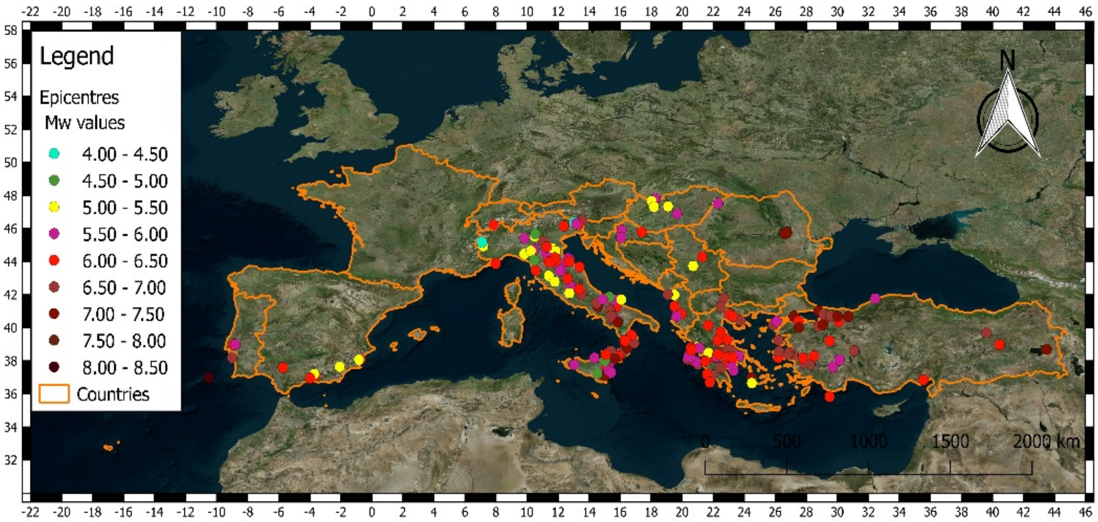



**Figure 2-18 Map showing the distribution of liquefaction manifestations included in the catalogue across Europe. The color of the circles is proportional to the event moment magnitude**

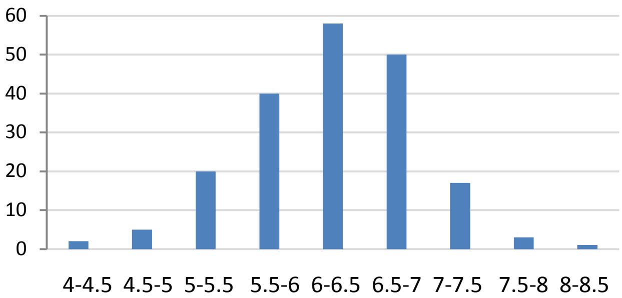



**Figure 2-19 Liquefaction manifestations included in the catalogue grouped basing on moment magnitude bin of 0.5.**

### 2.2.2 Definition of the return period associated to the seismic events in the catalogue

The recurrence interval was estimated through the bounded Gutenberg Richter relationship. The a- and b-parameters, as well as the upper magnitude to be used in the computation of the bounded Gutenberg-Richter, were retrieved from SHARE's seismogenic zones. This required to associate each earthquake to a SHARE's seismogenic zone, based on the geographical coordinates (and depth, if available) of the earthquake. Since SHARE defines four maximum magnitudes for each seismogenic zone, with relative weights, the upper magnitude was determined as the weighted average of the four maximum magnitude defined in SHARE, increased by 0.1 units. The lower magnitude was taken equal to 4.0. The recurrence interval was computed as the inverse of the activity rate associated with the magnitude of the earthquake.

Moreover, the earthquake catalogue was declustered trough the Burckhard and Gruenthal (2009)'s procedure in order to associate the mainshock's recurrence interval to the each seismic sequence (foreshocks-mainshock-aftershocks).

# 3. EUROPEAN REGRESSIONS TO PREDICT LIQUEFACTION OCCURRENCE STARTING FROM THE MAIN SEISMOLOGICAL INFORMATION OF AN EARTHQUAKE

## 3.1 State of the art

Early studies in the 1970s on the functional form linking earthquake magnitude and distance of the farthest liquefied site are presented in Section 3.1.1. The development of empirical relationships between earthquake distance and magnitude for liquefaction was examined by several authors in the past for different worldwide regions. Chronological review of literature magnitude-distance correlations for liquefaction is illustrated in Section 3.1.2. Finally, most recent insights on earthquake parameters thresholds for liquefaction triggering are presented in Section 3.1.3.

### 3.1.1 Early studies on functional form linking quake magnitude and liquefaction distance

Kuribayashi and Tatsuoka (1975) and then Youd (1977) were the first authors able to demonstrate the existence of a correlation between the magnitude of the earthquake that caused liquefaction and the distance of the farthest site in which liquefaction occurred. The goodness of this assumption is illustrated by Youd and Perkins (1978) starting from considerations concerning the main features of the seismic action, such as cyclic stress ratio, earthquake magnitude and number of the loading cycles. The cyclic shear stress ratio $\tau/\sigma'_{v0}$ and the number of loading cycles are linked by the following exponential equation:

$$\left(\frac{\tau}{\sigma'_{v0}}\right)^a N^b = c \qquad (3\text{-}1)$$

where:

- a, b and c are constant coefficients which depend on the soil type
- $\tau$ is the maximum shear stress
- $\sigma'_{v0}$ is the effective vertical stress

The cyclic shear stress ratio $\tau/\sigma'_{v0}$ is then expressed in (3-2) as a function of the amplitude of ground motions, which varies with the magnitude M and the distance from the seismic source r:

$$\frac{\tau}{\sigma'_{v0}} = k_1 r^{-k_2}\, e^{Mk_2} \qquad (3\text{-}2)$$

where $k_1$, $k_2$, $k_3$ are constant coefficients.

The number of loading cycles N is a measure of the duration of the seismic motion and therefore it varies with the magnitude M and the distance r as shown in (3-3):

$$N = m_1 r^{-m_3} e^{Mm_2} \qquad (3\text{-}3)$$

where $m_1$, $m_2$, $m_3$ are constant coefficients.

Substituting the equations (3-2) and (3-3) in (3-1), the relation (3-4) can be obtained:

$$\left(\frac{\tau}{\sigma'_{v0}}\right)^a N^b = k_1^a m_1^b r^{-(ak_2+bm_3)}\ e^{(ak_2+bm_2)M} \qquad (3\text{-}4)$$

By assuming that r is the maximum distance between the seismic source and the site where the ground shaking is strong enough to induce liquefaction (R) and extracting its logarithm, the equation (3-5) can be obtained:

$$\log\left(k_1^a m_1^b\right) + (ak_2 + bm_2)M - (ak_3 + bm_3)\log(R) \ = \log(c) \qquad (3\text{-}5)$$

From (3-5), M can be obtained by using the following relations:

$$M = \frac{\log(c) - \log\left(k_1^a m_1^b\right) + (ak_3 + bm_3)\log(R)}{(ak_2 + bm_2)} \qquad (3\text{-}6)$$

The equation (3-6) can be written as:

$$M = C_1 + C_2 \log(R) \qquad (3\text{-}7)$$

where:

- M is the magnitude of the earthquake that induced liquefaction.
- R is the maximum distance between the seismic source and the farthest site where liquefaction occurred. It can be expressed in terms of epicentral, hypocentral, and fault distance.

### 3.1.2 Bibliographic review of empirical magnitude-distance correlations for liquefaction

Kuribayashi and Tatsuoka (1975) are the first authors who developed magnitude-distance threshold relations for liquefaction using data from 44 historic Japanese earthquakes occurred between 1872 and 1968. The proposed relationships are shown in Figure 3-1.

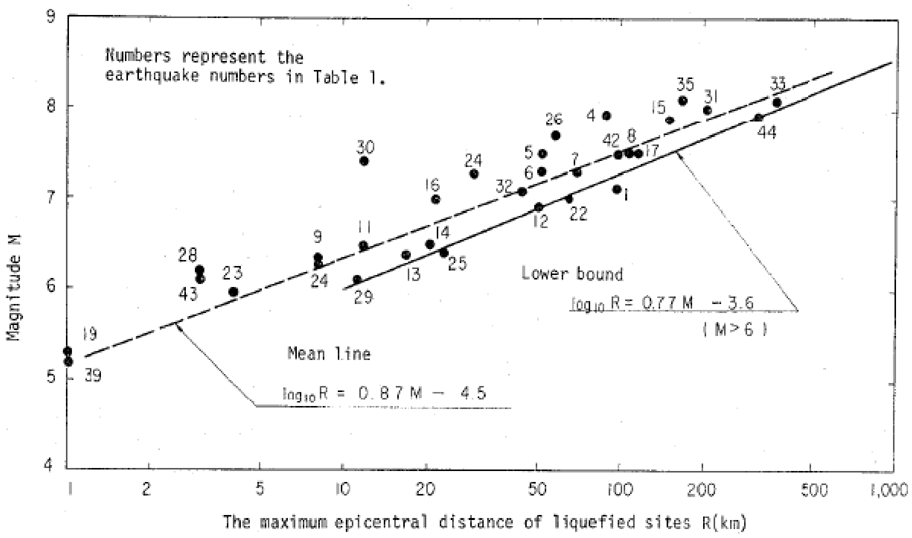



**Figure 3-1 Magnitude-distance threshold relations for liquefaction derived by Kuribayashi and Tatsuoka (1975) using data from 44 historic Japanese earthquakes that induced liquefaction**

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The relation proposed by Kuribayashi and Tatsuoka (1975) for magnitude greater then 6, was then updated by Tatsuoka in 1985 on the bases of the revision of magnitude assigned to earthquakes occurred prior to 1922. Indeed, these values were initially estimated from the macroseismic scale called "kawazumi", criticized for the presence of unreliable values. The comparison of the relationships derived by Kuribayashi and Tatsuoka in 1975 (a-a curve) and the updated version proposed by Tatsuoka in 1985 (b-b curve) are shown in Figure 3-2.

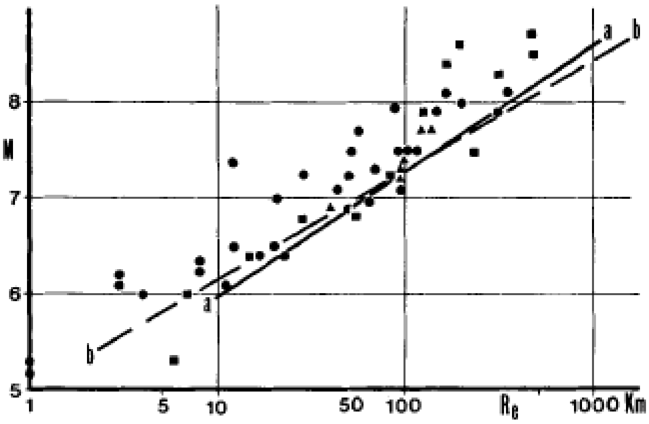


**Figure 3-2 Magnitude-distance threshold relations for liquefaction derived by Kuribayashi and Tatsuoka in 1975 (a-a) and the version updated by Tatsuoka in 1985 (b-b)**

Youd (1977) and Youd and Perkins (1978) introduced the idea of measuring the distance from the fault rather than from the epicenter for liquefaction that occurred during several earthquakes in the USA. Keefer (1984) collected data from 40 historical earthquakes and presented new curves of magnitude versus epicentral distance, showing an exponential increase in distance at higher magnitude values.

In 1988, Ambraseys proposed two new type of relations starting from liquefaction manifestations occurred during 137 earthquakes. The following sources was adopted:

- 39 out of 44 Japanese earthquakes identified by Kuribayashi and Tatsuoka (1975)
- 14 earthquakes occurred worldwide retrived from Youd (1977)
- 6 earthquakes occurred worldwide retrieved from Davis and Berrill (1983)
- 7 earthquakes occurred worldwide retrieved from Fairless and Berrill (1984)
- 70 new cases identified by Ambraseys himself.

The first type of relation proposed by Ambraseys (1988) is expressed in terms of moment magnitude and epicentral distance (in centimeters). The choice to express the epicentral distance in cm is at least questionable. This relation (a-a curve) is shown in Figure 3-3, where it is compared with the Kuribayashi and Tatsuoka (1975) correlation (b-b curve). A few points in Figure 3-3 are located below the proposed threshold curve. Indeed, Ambraseys states that with reference to magnitude-distance pairs outside the curve, the liquefaction is very unlikely to occur except for sites characterized by rare predisposing conditions such as extremely soft soil deposits.

The second type of empirical relation developed by Ambraseys (1988) is expressed in terms of moment magnitude and fault distance. Figure 3-4 shows the magnitude-fault distance threshold relations for liquefaction proposed by Ambraseys (1988).

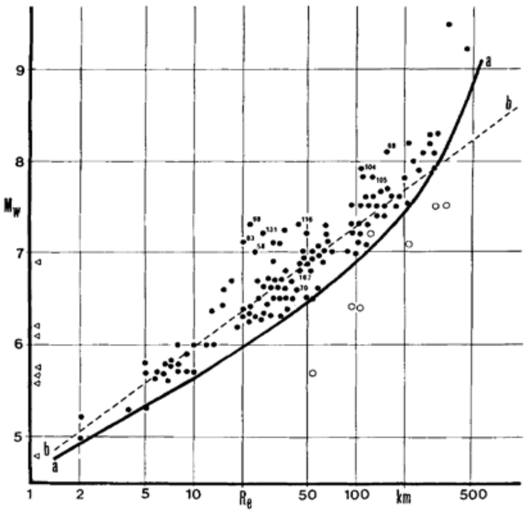


**Figure 3-3 Magnitude-epicentral distance threshold relations by Ambraseys (1988) for liquefaction (a-a) compared to the Ambraseys and Tatsuoka (1975) relation (b-b)**

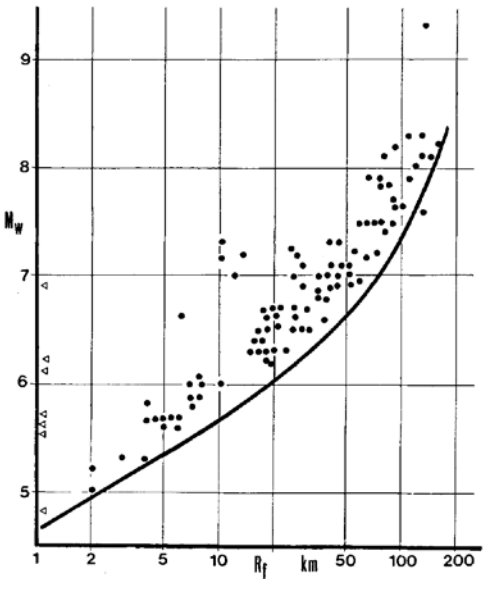


**Figure 3-4 Magnitude-fault distance threshold relations for liquefaction proposed by Ambraseys (1988)**

Ambraseys (1991) used 137 worldwide liquefaction cases, in a wide variation of tectonic and sedimentary settings, and correlated a uniform type of magnitude (moment magnitude) both with epicentral distance Re (in centimeters; namely the farthest observed liquefaction correlation between maximum epicentral distance effect) and fault distance Rf (in centimeters).

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Galli and Meloni (1993) and Galli and Ferreli (1995) collected liquefaction data reported during several historical earthquakes in Italy and placed a limiting distance of liquefaction occurrence on the basis of epicentral intensity (Io, MCS scale) versus epicentral distance (in kilometers).

Papadopoulos and Lefkopoulos (1993) extended the Ambraseys database with 30 new cases of liquefaction occurred in Greece since 1767, generated by seismic events with a magnitude Ms ranging between 5.8 and 7.2, and 2 American evidences of liquefaction (Loma Prieta and Falcon State) and 1 from New Zealand (Edgecumbe). These authors developed different curves based on different magnitude ranges and different regions. The relations are shown in Figure 4.5, where the proposed curves are compared with those realized by Ambraseys (1988) and Kuribayashi and Tatsuoka (1975). Indeed, the plotted curves are:

- α-α: Papadopoulos and Lefkopoulos (1993) for Greek earthquakes and 5.8 ≤ Ms ≤ 5.9
- b-b: Papadopoulos and Lefkopoulos (1993) for Greek earthquakes and Ms > 5.9
- c-c: Ambraseys (1988) relation
- d-d: Kuribayashi and Tatsuoka (1975) relation
- e-e: Papadopoulos and Lefkopoulos (1993) for worldwide earthquakes.

Papadopoulos and Lefkopoulos (1993) developed also empirical threshold curves in terms of moment magnitude and fault distance for both the Greek territory and also by using all the data they collected.

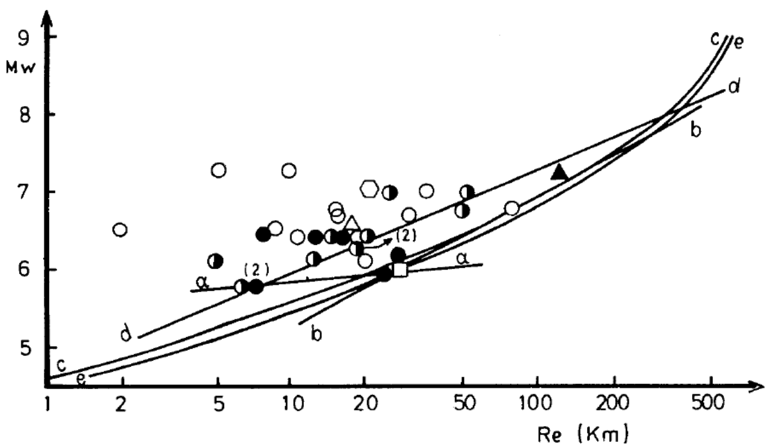


**Figure 3-5 Magnitude-distance threshold relations by Papadopoulos and Lefkopoulos (1993) for liquefaction (α-α for Greek earthquakes and 5.8 ≤ Ms ≤ 5.9, b-b for Greek earthquakes and Ms > 5.9, e-e for worldwide earthquakes) compared to the Ambraseys (1988) correlation (c-c) and Ambraseys and Tatsuoka (1975) relation (d-d), respectively**

Wakamatsu (1993) extended the work of Kuribayashi and Tatsuoka (1975) by adding 46 new data from Japanese earthquakes.

In Italy, historical research on collections of liquefaction-induced phenomena was updated by Galli (2000) as illustrated in Section 2.1.1. This work allowed Galli to highlight the distribution of intensity/magnitude values versus epicentral distance. Figure 3-6 shows, for example, the distribution of earthquake-induced liquefaction cases in terms of Ms and epicentral distance for the period 1117-1990 (A) and 1900-1990 (B). Ms values in (B) are from instrumental measurements. The bounding equations (dashed lines in Figure 3-6) were proposed by Galli (2000).

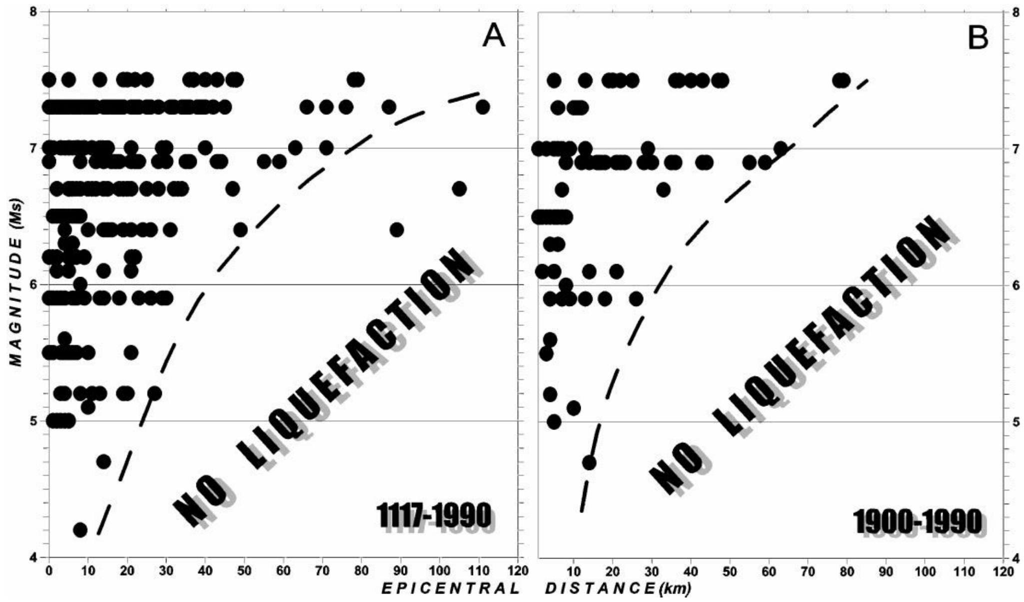


**Figure 3-6 Distribution of earthquake-induced liquefaction cases in terms of Ms and epicentral distance for the period 1117-1990 (A) and 1900-1990 (B). Ms values in (B) are from instrumental measurements. The bounding equations (dashed lines) were proposed by Galli (2000)**

In Turkey, Aydan et al. (2000) re-evaluated seismic parameters of Turkish earthquakes and developed relationships in terms of Ms and hypocentral distance.

Starting from DALO (Section 2.1.1), Papathanassiou (2004) developed for the Aegean territory empirical Ms-Repi threshold curve with reference to the 5.5 ≤ Ms ≤ 7.6 magnitude range. Although the curve (shown in Figure 3-7) was computed starting from the instrumental data only (black dots), the limit relation is also valid for the whole catalogue.

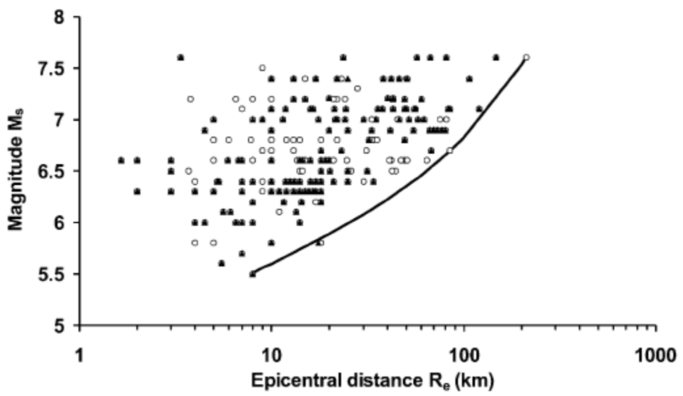


**Figure 3-7 Magnitude-distance threshold relations by Papathanassiou et al. (2005) for the Aegean territory. Black dots represent the data which correspond to the instrumental period**

Pirrotta et al. (2007) presents an updated dataset of liquefaction phenomena in central-eastern Sicily and associated threshold curves in terms of epicentral distance and both Mw and Ms magnitude (Figure 3-8). For the first time, coefficients computed from regressions are associated to a certain level of uncertainty.

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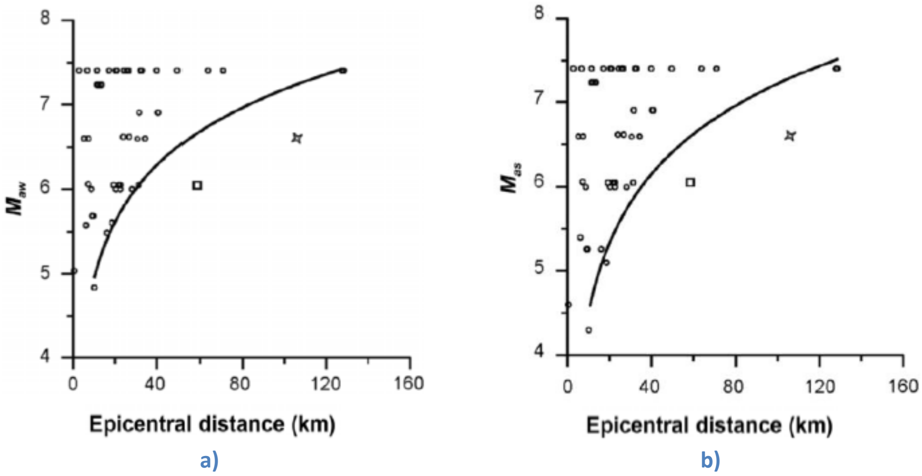


**Figure 3-8 Magnitude-distance threshold relations by Pirrotta et al. (2007) for the central-eastern Sicily (Italy). Curves were developed in terms of both Mw (a) and Ms (b) magnitude**

Starting from CEDIT database, Martino et al. (2014) shows the magnitude-distance distribution for liquefaction of Figure 3-9. The main inference, stated in the paper, is that liquefaction needs more accurate investigations during earthquakes in order to be properly addressed and parameterised so that some conclusive relationships can be drawn.

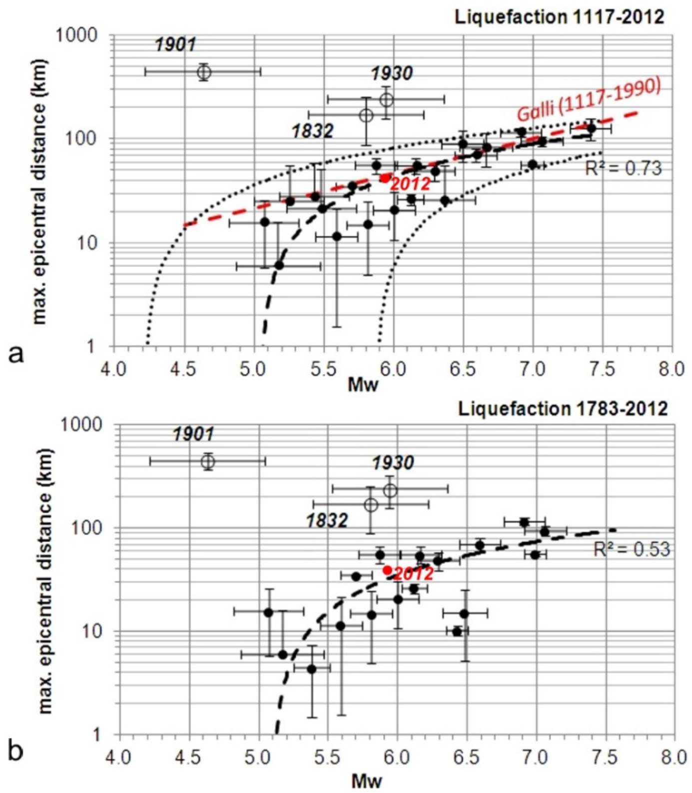


**Figure 3-9 Magnitude-distance relationships for liquefaction in different time periods (a: 1117–2012; b: 1783–2012). In (a) the comparison with the upper bound curve by Galli (2000) is shown (red dashed line). Black dotted lines in (a) refer to two standard errors across the best-fit line (black dashed line). The red full circle corresponds to the liquefaction effects of the 2012 Emilia quake. Few outliers are the black open circles) discarded from the regression analysis**

### 3.1.3 Most recent insights on earthquake parameters thresholds for liquefaction triggering

Zhou et al. (2018) compiled a large amount of liquefaction case histories in the 2008 Wenchuan earthquake and then established a relationship between the energy absorption ratio and damping ratio to obtain the typical threshold imparted energy of seismic waves. A seismic energy attenuation model was proposed specifically for line type of fault rupture like the 2008 Wenchan earthquake. Then the liquefaction distance limit for the Mw=7.9 main shock was estimated based on an earthquake magnitude-energy-distance relationship, and validated by the field case histories.

In 2018, the Center for Geotechnical Practice and Research at Virginia Polytechnic Institute and State University published a report titled "Smallest Earthquake Magnitude that Can Trigger Liquefaction" (Green and Bommer, 2018) aimed to establish if there is a magnitude threshold below which the possibility of triggering liquefaction can be discounted. Such a lower bound for liquefaction triggering is also required for probabilistic liquefaction hazard analyses, PLHA (e.g., Kramer and Mayfield 2007). Based on field observations and a simple parametric study, Green and Bommer (2018) conclude that earthquakes as small as moment magnitude 4.5 can trigger liquefaction in extremely susceptible soil deposits but these correspond to site conditions where building construction is not viable. For soil profiles that are sufficiently competent to support foundation loads, the minimum earthquake magnitude for the triggering of liquefaction should be about 5. Green and Bommer (2018) therefore propose that in liquefaction hazard assessments for engineering applications, magnitude 5.0 be adopted as the minimum earthquake size considered.

Green and Bommer (2018) discussed also whether it would not be more appropriate to define the minimum level of ground shaking that might trigger liquefaction. Liquefaction triggering is controlled by both the amplitude (most usually peak ground acceleration, PGA) and the duration (or number of cycles of motion) simultaneously. Therefore, for earthquakes occurring at short distances from the site of interest, the magnitude is potentially a good indicator of the capacity of the motion to trigger liquefaction since both PGA and duration depend on magnitude - and display inverse dependence on distance (Lasley et al., 2017). Moreover, residuals of PGA and duration with respect to median predictions from GMPEs are found to be negatively correlated (Bradley, 2011). Studies that have focused on thresholds of PGA for liquefaction triggering have normalized the peak acceleration values to a common reference magnitude precisely to account for the influence of duration (Santucci de Magistris et al., 2013). Absolute minimum PGA thresholds for liquefaction could be defined on the basis of lower amplitudes of motion being incapable of inducing sufficient strain generate excess pore water pressure in the soil, which is requisite for liquefaction triggering (Dobry et al., 1982, Rodriguez-Arriaga and Green, 2018) but to use such an approach for screening of liquefaction hazard would require estimation of PGA values. For PLHA, there may be benefits of defining a lower bound for hazard contributions based on a ground-motion parameter, or vector of parameters, but Cumulative Absolute Velocity (CAV, adopted in Probabilistic Seismic Hazard Analysis) may not be the most suitable metric for this purpose (Green and Bommer, 2018).

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## 3.2 Novel correlations based on the European catalogue of liquefaction cases

On the basis of the liquefaction occurrences catalogue, calculation of European regressions to predict liquefaction occurrence from the main seismological information of an earthquake was carried out by UNIPV-Eucentre. A code was purposely-developed in this study for the calculation of the empirical regressions. The adopted functional form is the one proposed by Youd and Perkins (1978). The input data in term of magnitude-distance couples are extracted from the catalogue. Data are subdivided into bins of increasing magnitude and, within each bin, the magnitude-distance couple referred to the maximum distance in the bin is selected. Size of the magnitude bin can influence the selection of data, thus sensitivity analysis have been carried out by considering magnitude bin of 0.25, 0.5, 1, and 2. Once the magnitude-distance couples are identified, the threshold curve is calculated using a nonlinear least squares regression.

### 3.2.1 Empirical correlations of moment magnitude versus epicentral distance

Empirical correlations of moment magnitude versus epicentral distance are computed herein on the basis of the 920 magnitude-distance couples from the European liquefaction occurrences catalogue. Indeed:

- for Europe (Figure 3-10):

$$M_w = 1.377 + 2.394 \log(R_{epi}) \quad (3\text{-}8)$$

- for Italy (Figure 3-11):

$$M_w = 0.921 + 2.596 \log(R_{epi}) \quad (3\text{-}9)$$

- for Eastern Europe (Figure 3-12):

$$M_w = 1.895 + 2.187 \log(R_{epi}) \quad (3\text{-}10)$$

- for Western Europe (Figure 3-13):

$$M_w = 1.602 + 2.372 \log(R_{epi}) \quad (3\text{-}11)$$

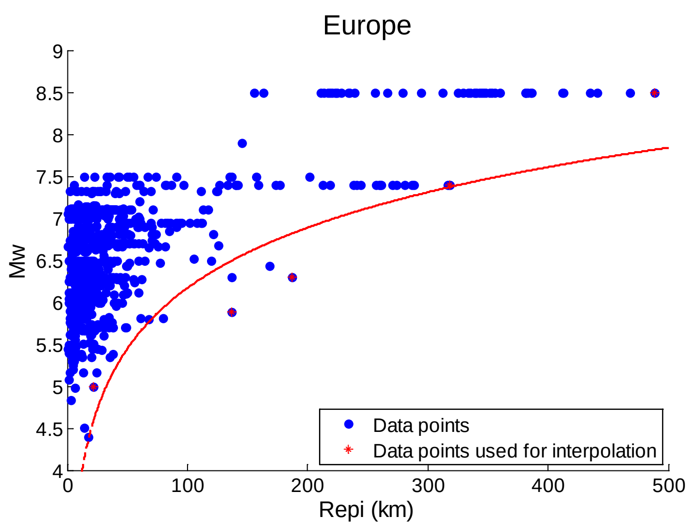


**Figure 3-10 Empirical correlations of moment magnitude versus epicentral distance computed in this study for Europe**

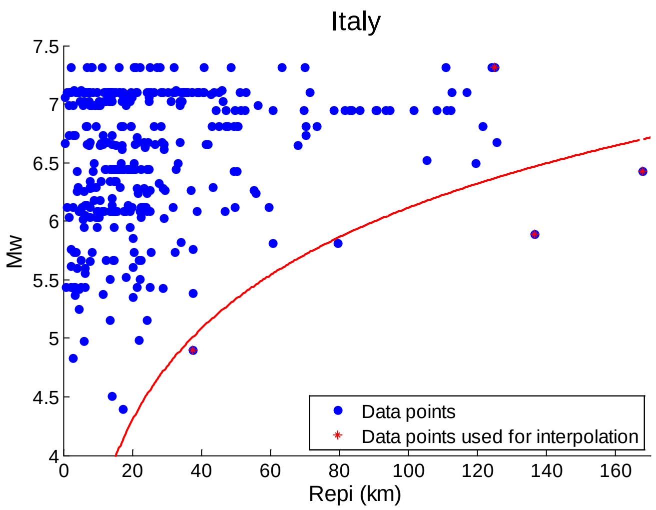


**Figure 3-11 Empirical correlations of moment magnitude versus epicentral distance computed in this study for Italy**

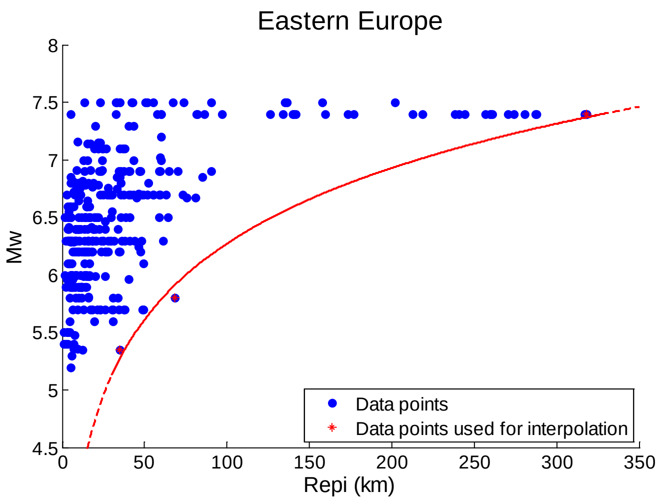


**Figure 3-12 Empirical correlations of moment magnitude versus epicentral distance computed in this study for Eastern Europe**

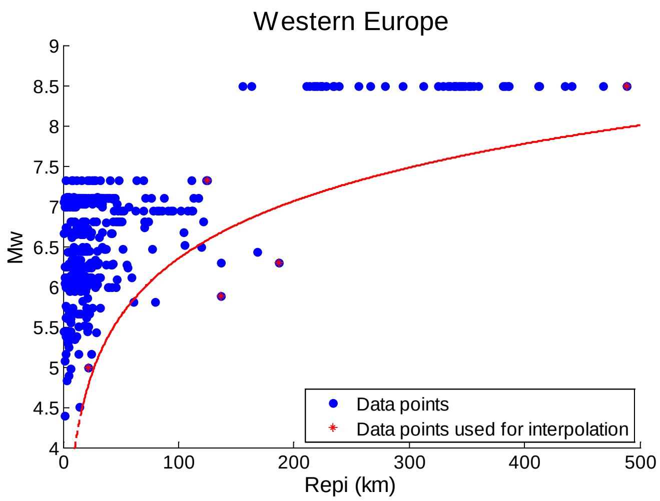


**Figure 3-13 Empirical correlations of moment magnitude versus epicentral distance computed in this study for Western Europe**

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### 3.2.2 Empirical correlations of moment magnitude versus hypocentral distance

Starting from the 488 magnitude-distance couples for which the earthquake depth is available, empirical correlations of moment magnitude versus hypocentral distance are computed in this study:

- for Europe (Figure 3-14):

$$M_w = 1.492 + 2.335\log(R_{hypo}) \quad (3\text{-}12)$$

- for Italy (Figure 3-15):

$$M_w = 1.783 + 2.449\ \log(R_{hypo}) \quad (3\text{-}13)$$

- for Eastern Europe (Figure 3-16):

$$M_w = 1.516 + 2.330\log(R_{hypo}) \quad (3\text{-}14)$$

- for Western Europe (Figure 3-17):

$$M_w = 1.974 + 2.202\log(R_{hypo}) \quad (3\text{-}15)$$

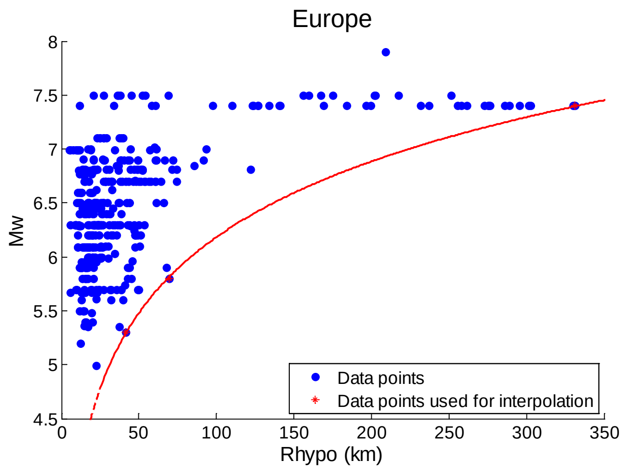


**Figure 3-14 Empirical correlations of moment magnitude versus hypocentral distance computed in this study for Europe using data from the catalogue for which hypocentral depth is available**

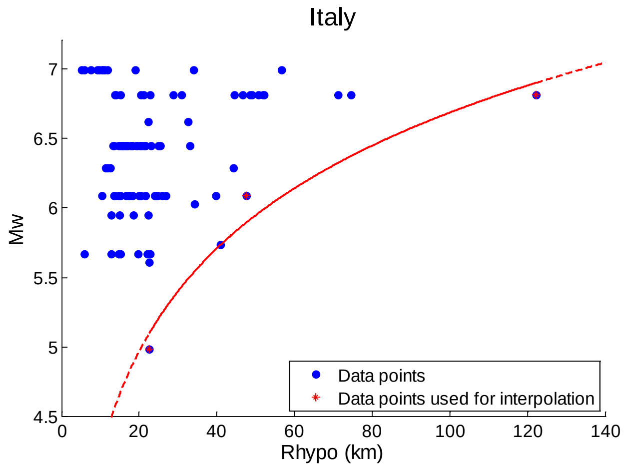


**Figure 3-15 Empirical correlations of moment magnitude versus hypocentral distance computed in this study for Italy using data from the catalogue for which hypocentral depth is available**

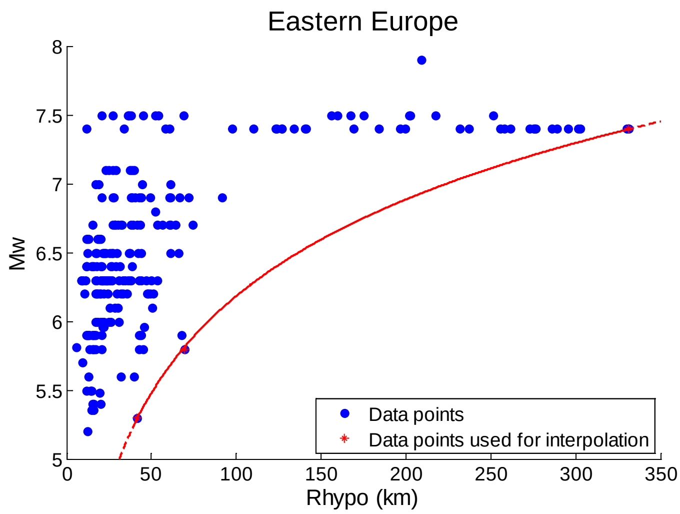


**Figure 3-16 Empirical correlations of moment magnitude versus hypocentral distance computed in this study for Eastern Europe using data from the catalogue for which hypocentral depth is available**

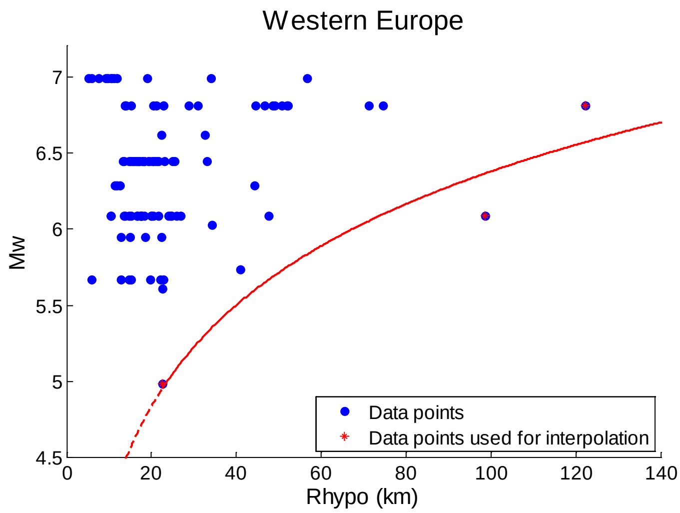


**Figure 3-17 Empirical correlations of moment magnitude versus hypocentral distance computed in this study for Western Europe using data from the catalogue for which hypocentral depth is available**

Since for less than half of the data in the catalogue the depth of the earthquake is not available, it has been decided to estimate the earthquake depth starting from the seismogenic zones defined within the SHARE project. Figure 2-15 show the map of the seismogenic zones defined for Europe within the SHARE project and the location of liquefaction manifestations included in the catalogue built in this study. The estimates of the depth obtained using this approach should be considered valid only in first approximation. Thus, a code for calculating non-linear weighted least-square regression was implemented. In this framework, the weight assigned to data for which the hypocentral depth is available in the catalogue is twice the weight assigned to data for which the hypocentral depth was assumed starting from the SHARE seismogenic zones.

Empirical correlations of moment magnitude versus hypocentral distance computed using all the data in the catalogue are the following:

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- for Europe:

$$M_w = -0.6791 + 3.237\, log\left(R_{hypo}\right) \tag{3-16}$$

- for Italy:

$$M_w = 0.365 + 2.845\, log\left(R_{hypo}\right) \tag{3-17}$$

- for Eastern Europe:

$$M_w = 1.516 + 2.333\, log\left(R_{hypo}\right) \tag{3-18}$$

- for Western Europe:

$$M_w = -0.7586 + 3.2825\, log\left(R_{hypo}\right) \tag{3-19}$$

The comparison among the relations in equations (3-13) and (3-17) for Italy are shown Figure 3-19a and the comparison among the relations for Europe in equations (3-15) and (3-19) are shown in Figure 3-19b.

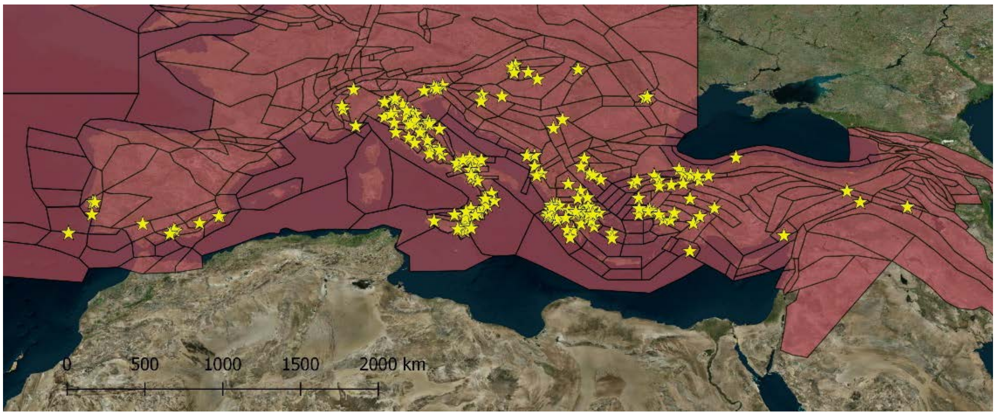
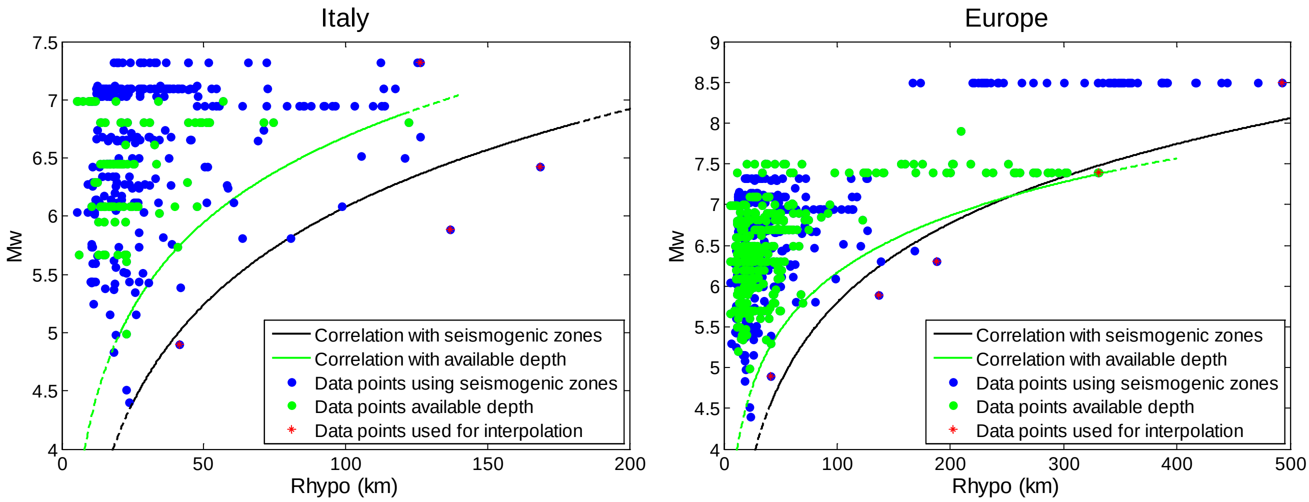



**Figure 3-18 Map of the seismogenic zones defined for Europe within the SHARE project and the location of liquefaction manifestations included in the catalogue built in this study**




**a)** **b)**

**Figure 3-19 Comparison among empirical correlations of moment magnitude versus hypocentral distance computed in this study for Italy (a) and fro Europe (b) using only data for which hypocentral depth is available and using all data (including data for which the hypocentral depth was assumed starting from the SHARE seismogenic zones)**

### 3.2.3 Comparison between novel and literature correlations

Comparisons between novel relations proposed in this study and correlations selected from literature, i.e. for Italy (i.e. Galli, 2000) and for Turkey (i.e. Aydan et al., 2000), are herein presented.

In order to compare the empirical curve developed in this study for Italy (Section 3.2.1) and the curve proposed by Galli (2000), first of all a Mw-Ms relation was developed starting from data in the most recent version of the Italian Catalogue of earthquakes. Figure 3-20 shows the Mw-Ms relation herein developed.

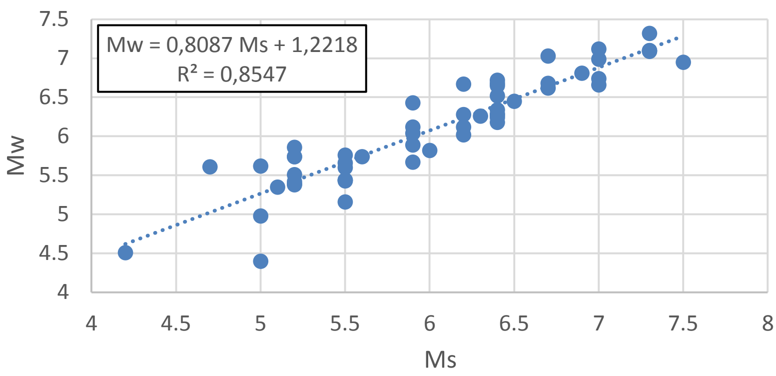



**Figure 3-20 Mw-Ms correlation developed for the Italian territory in this study**

Thus, the threshold correlation by Galli (2000) was expressed in terms of Mw and then compared to the empirical Mw-Repi relation proposed in this study (Figure 3-21). The Galli (2000) curve seems less conservative than the one calculated herein. This can be due to the post-1990 cases included in the updated version of the catalogue of liquefaction occurrences developed herein for Italy. Furthermore, the uncertainty deriving from the application of the Ms-Mw conversion between should also be considered.

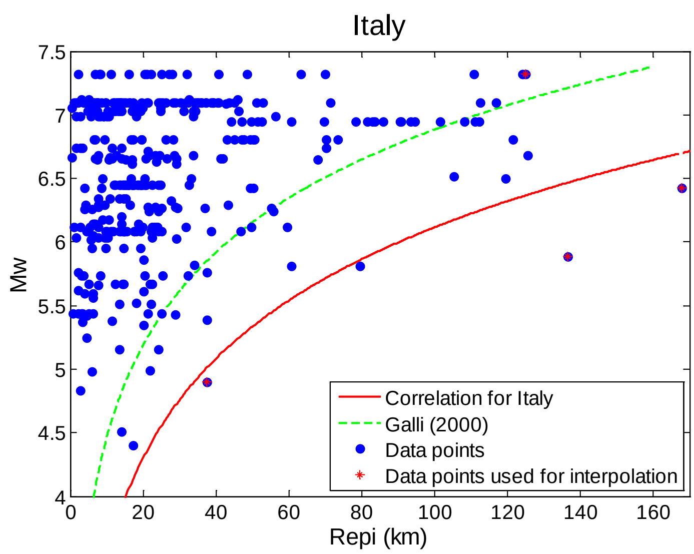



**Figure 3-21 Comparison among the Mw-Repi threshold correlation developed for the Italian territory in this study and the curve by Galli (2000)**

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Aydan et al. (2000) developed relationships for Turkey in terms of Ms and hypocentral distance. Again, it was necessary to elaborate the original relations in order to express it in terms of Mw. The conversion correlation proposed by Kadirioglu and Kartal (2016) for the Turkish territory was adopted. An empirical correlation of moment magnitude versus hypocentral distance computed using all the data in the catalogue as illustrated 3.2.2, was developed herein for Turkey. The equation is:

$$M_w = 0.4554 + 3.232\ log\ (R_{hypo}) \quad (3\text{-}20)$$

Figure 3-22 shows the comparison among the Mw-Rhypo threshold correlation developed for Turkey in this study and the curve proposed by Aydan et al. (2000). It is worth noting that the curve developed in this study seems to be more conservative especially for magnitude greater than 7.

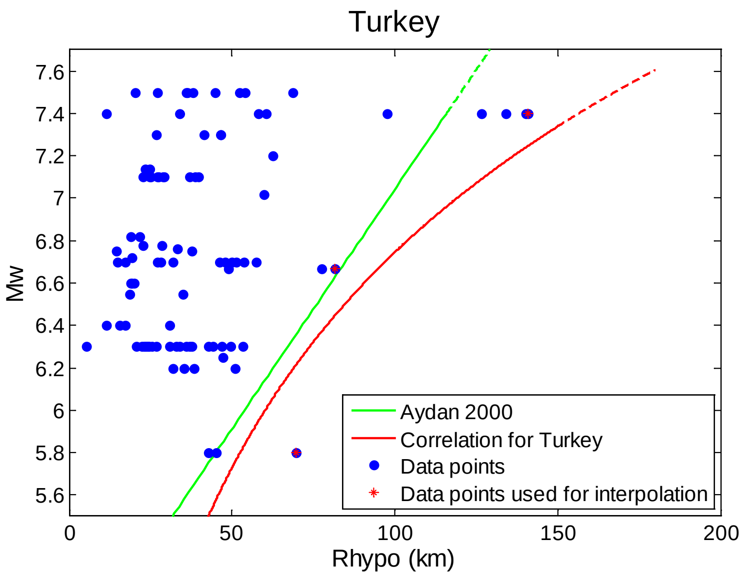


**Figure 3-22 Comparison among the Mw-Rhypo threshold correlation developed for Turkey in this study and the curve by Aydan et al. (2000)**

## 3.2.4 Empirical correlations for different types of liquefaction manifestations

An attempt to develop empirical correlations for different types of liquefaction manifestations has been carried out in this study. In particular, the following relations was computed:

- for sand boils (Figure 3-14):

$$M_w = 1.173 + 2.752\ \log(R_{epi}) \quad (3\text{-}21)$$

- for ground cracks (Figure 3-24):

$$M_w = 1.095 + 2.655\ \log(R_{epi}) \quad (3\text{-}22)$$

The difference among the coefficients of the two above relationships are negligible.

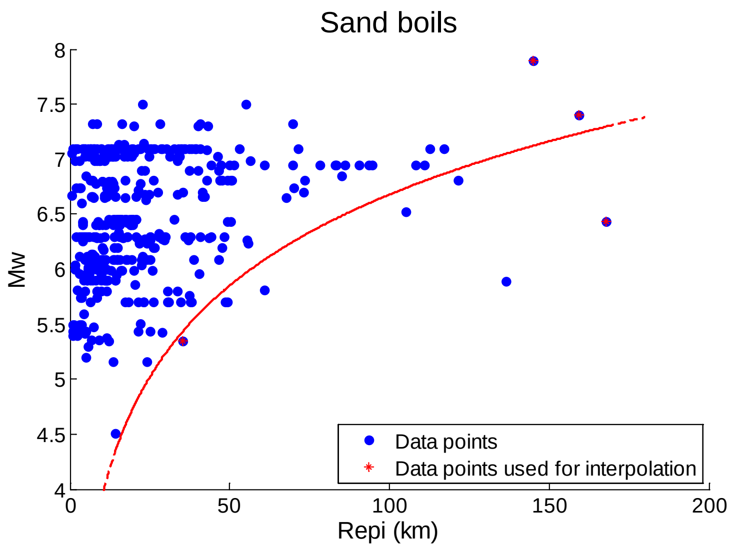


Figure 3-23 European empirical correlations of moment magnitude versus epicentral distance computed in this study for liquefaction manifestations such as sand boils

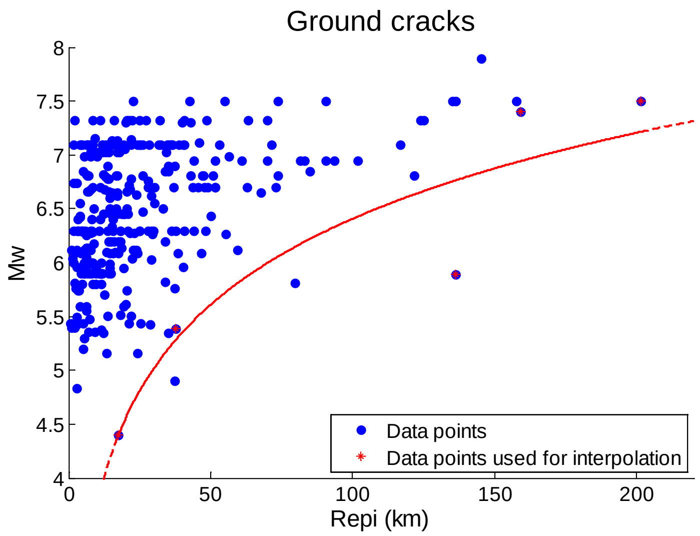


Figure 3-24 European empirical correlations of moment magnitude versus epicentral distance computed in this study for ground cracks induced by liquefaction

### 3.2.5 Empirical correlations in terms of earthquake magnitude-depth-epicentral distance

The analysis of the 488 cases of liquefaction for which the depth of the seismic event is known has brought to light a relationship between the focal depth of the hypocenter and the maximum distance at which liquefaction was recorded. This relationship is based on the assumption that, with the same magnitude of the seismic event, the increase in the depth of the epicenter, at least up to certain values, corresponds to an increase in the area at surface that is affected by the effects of the earthquake.

To verify this hypothesis, the data from the catalogue were subdivided into magnitude bin of 0.5 and the couples of the focal depth of the earthquake triggering liquefaction and epicentral distance between epicenter and the liquefied site were compared (Figure 3-25). Figure 3-25b shows, for example, for

6<Mw<6.5, how the maximum distance at which liquefaction was recorded increases with the increase of the focal depth of the triggering earthquake up to depth values of about 20km. Beyond this depth the attenuation phenomena become preponderant therefore the area of resentment of the earthquake tends to decrease.

Starting from these data it was therefore possible to develop some curves that link the maximum distance at which the liquefaction occurred and the depth of the triggering seismic event; the adopted functional form is:

$$R_{epi} = a \cdot D^2 + b \cdot D + C \quad (3\text{-}23)$$

where

- Repi is the maximum distance where liquefaction was induced by the earthquake
- D is the focal depth of the earthquake
- a,b,c are coefficients computed through the regression carried out using the *polyfit* function available in MatLAB® (https://it.mathworks.com).

European empirical correlations in terms of earthquake magnitude-depth-epicentral distance have been therefore computed in this study for different magnitude ranges:

- for Mw<6 (Figure 3-25a):

$$R_{epi} = -0.129\, D^2 + 5.3577\, D + 6.7786 \quad (3\text{-}24)$$

- for 6<Mw<6.5 (Figure 3-25b):

$$R_{epi} = -0.0779\, D^2 + 3.5105\, D + 20.701 \quad (3\text{-}25)$$

- for 6.5<Mw<7 (Figure 3-25c):

$$R_{epi} = -0.314\, D^2 + 11.281\, D + 10.0446 \quad (3\text{-}26)$$

- for 7<Mw<7.5 (Figure 3-25d):

$$R_{epi} = -0.0298\, D^2 + 5.2116\, D + 91.3282 \quad (3\text{-}27)$$

From the curves presented in Figure 3-25 it turns out that with the increase of the focal depth, the resentment area in which the liquefaction triggering is possible is greater. For earthquakes with a magnitude smaller then 7, the area of resentment increases for increasing depths up to 20-25km, then because of the attenuation of the seismic waves the area of resentment starts to decrease. For magnitudes greater than 7, the depth corresponding to the maximum epicentral distance is about 90km. For this magnitude range, the data must be considered with caution both for the low number of seismic events of such magnitude within the catalogue, and for the presence of data coming from the Vrancea area in Romania which has peculiar characteristics compared to the rest of the European territory.

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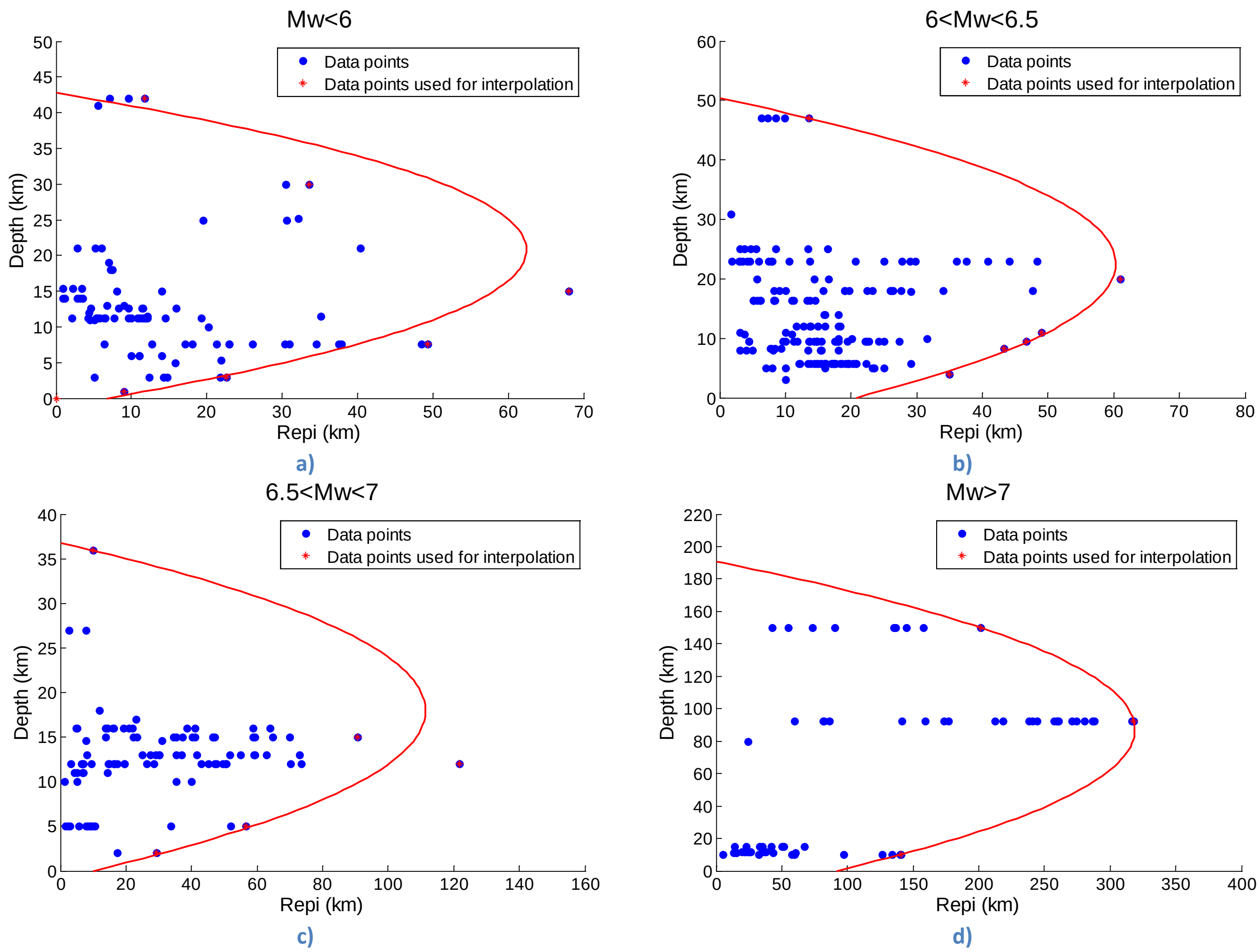


**Figure 3-25 European empirical correlations in terms of earthquake magnitude-depth-epicentral distance computed in this study for different magnitude ranges: Mw<6 (a), 6<Mw<6.5 (b), 6.5<Mw<7 (c), and 7<Mw<7.5 (d)**

## 3.3 Computation of novel magnitude-distance correlations taking into account the uncertainties

Uncertainties on magnitude and epicentral distance were taken into account by randomly varying magnitude and epicentral distance within Gaussian probability distributions. The standard deviation was taken equal to 1/3 of the uncertainty associated with the moment magnitude and epicentral distance. Uncertainties where retrieved from the catalogue, if available. Otherwise, the assessment of the uncertainties was carried out based on expert judgement, reflecting the improvement in estimating earthquake magnitudes and epicentres over the years. The length of the earthquake catalogue was split into three periods and a value of uncertainty for moment magnitude was associated to each of these, as reported in table (Table 3-1). If not given in the catalogue, the uncertainties on epicentral distance were retrieved from the work by Zuccolo et al. (2013), in which the authors proposed uncertainty values on epicentral distance for Italy (Table 3-2).

**Table 3-1 Uncertainties adopted in the estimation of earthquake magnitudes**

| Year | Error on magnitude |
|---|---|
| ≤1799 | 0.3 |
| 1800-1969 | 0.2 |
| ≥1970 | 0.1 |

**Table 3-2 Uncertainties adopted in the estimation of epicentral distances (Zuccolo et al. 2013)**

| Year | Error on distance (km) |
|---|---|
| ≤1799 | 30 |
| 1800-1899 | 15 |
| 1900-1969 | 10 |
| ≥1970 | 5 |

A large number (10.000) of magnitude-distance realizations were generated. A set of boundary points was selected for each realization, as follows:

- the magnitude range was subdivided in bins with amplitude 0.5;
- for each magnitude bin, the point with the largest epicentral distance was selected;
- the points with decreasing distance at increasing magnitude were discarded.

The procedure was repeated for the 10000 realizations. An orthogonal distance regression with the form $M_w$=a+b*log($R_{epi}$) was applied to all boundary points. The python package *scipy.odr* was adopted to implement the orthogonal distance regression. The procedure was applied for the entire European territory and for three sub-catalogues corresponding to three regions: Italy (with maximum distance=200 km), Eastern Europe and Western Europe. The obtained limit curves (Figure 3-26) are:

- for Europe:

$$M_w = 1.969 + 0.928 \log(R_e) \quad (3\text{-}28)$$

- for Italy:

$$M_w = 3.086 + 0.626 \log(R_e) \quad (3\text{-}29)$$

- for Eastern Europe:

$$M_w = 3.793 + 0.596 \log(R_e) \quad (3\text{-}30)$$

- for Western Europe:

$$M_w = 2.235 + 0.881 \log(R_e) \quad (3\text{-}31)$$

From Figure 3-26 it is evident that the computed limit curve for Eastern Europe is not satisfactory, since this region suffers of lack of data at $M_w$>6 and epicentral distances>100 km. The comparison among the computed curves is given in Figure 3-27, showing that the limit curves for the entire Europe and Western Europe are almost coincident, while the limit curve of Eastern Europe exhibits the problem mentioned above. Therefore, we suggests to use the limit curve computed for the entire Europe both in Eastern Europe and Western Europe. Concerning Italy, the more conservative limit curve computed considering only Italian data can be used.

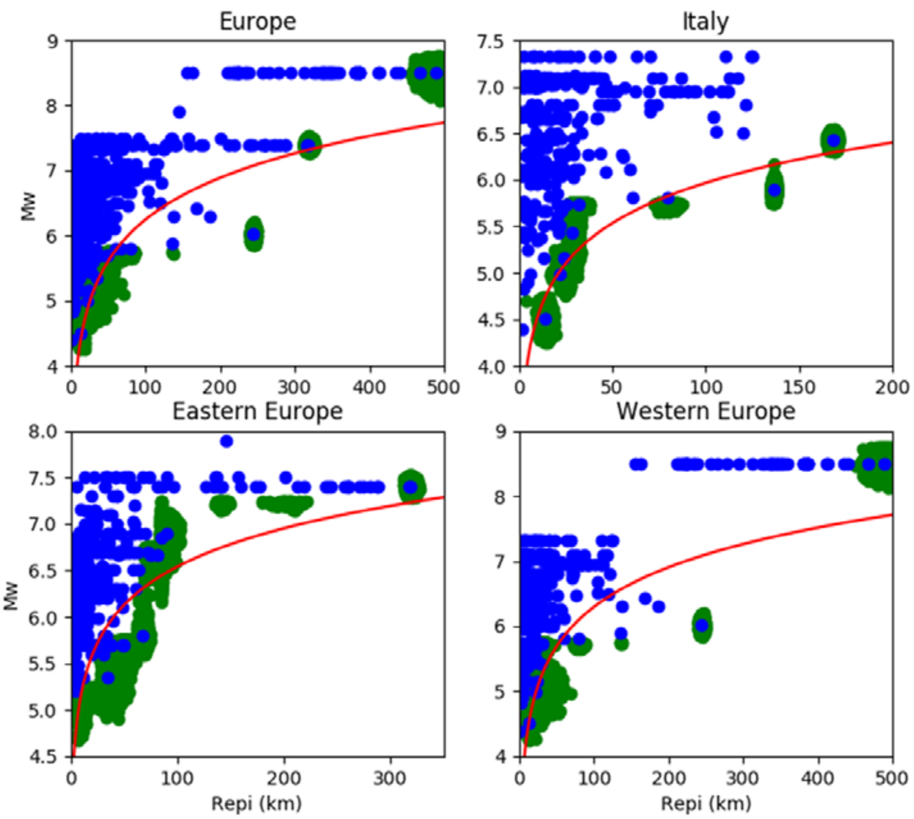


**Figure 3-26 Limit curves (red lines) computed in this study for different regions. The blue points are the data given in the catalogue, while the green points are the (perturbed) boundary points used to compute the limit curves**

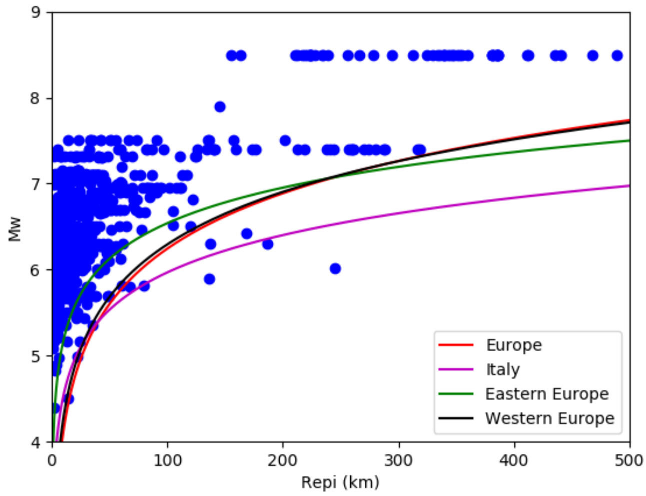


**Figure 3-27 Comparison among the computed limit curves. The blue points corresponds to the data of the whole catalogue**

## 3.4 Contributions towards the definition of a peak acceleration threshold for soil liquefaction

The peak acceleration threshold for soil liquefaction was estimated by computing the PGAs associated with the magnitude and distance pairs of the computed limit curve for Europe (Figure 3-26; Figure 3-27). In the specific, PGA values were determined through the ground motion prediction equation by Akkar et al. (2014) for EC8 subsoil classes B ($Vs_{30}$=600 m/s), C ($Vs_{30}$=270 m/s) and D ($Vs_{30}$=150 m/s). For each considered subsoil class, the PGA threshold was assumed to be equal to the minimum computed PGA value (Table 3-3).

**Table 3-3 PGA thresholds for Europe computed through the GMPE by Akkar et al. (2014). Both average values and average values increased by one standard deviation were considered**

| **EC8** | **PGA (g)** | **PGA threshold for Italy (g)** |
|---|---|---|
| | AVERAGE | AVERAGE + std.dev |
| B | 0.011 | 0.023 |
| C | 0.015 | 0.031 |
| D | 0.017 | 0.035 |

The PGA thresholds given in Table 3-3 are very low, therefore they suggests to not define a PGA threshold for liquefaction in seismic codes.

PGA thresholds were also computed for the Italian territory using the Italian ground motion prediction equation by Bindi et al. (2011), in addition to the European Akkar et al. (2014). The results are given in Table 3-4. As expected, PGA thresholds for the Italian territory are even lower than those for the European territory.

**Table 3-4 PGA thresholds for Italy computed through the GMPE by Akkar et al. (2014) and Bindi et al. (2011). Both average values and average values increased by one standard deviation were considered**

| **EC8** | **PGA (g)** Akkar et al. (2014) | **PGA (g)** Bindi et al. (2011) | **PGA (g)** Akkar et al. (2014) | **PGA (g)** Bindi et al. (2011) |
|---|---|---|---|---|
| | AVERAGE | | AVERAGE + std.dev | |
| B | 0.004 | 0.005 | 0.009 | 0.011 |
| C | 0.006 | 0.006 | 0.013 | 0.013 |
| D | 0.007 | 0.004 | 0.015 | 0.010 |

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# 4. CONCLUDING REMARKS

A homogeneous and composite catalogue of liquefaction manifestations occurred in Europe was compiled by UNIPV-Eucentre in a GIS environment. Not surprisingly, it turns out that almost all the liquefaction cases occurred in the European countries located in the Mediterranean region since they are characterized by highest seismic hazard.

Basing on this catalogue, various European empirical correlations to predict liquefaction starting from the main seismological characteristics of an earthquake were developed. These empirical curves can be updated by adding further data in the catalogue. Estimating the possible region of liquefaction occurrence during a strong earthquake is highly valuable for economy loss estimation, reconnaissance efforts and site investigations after the event. These type of correlations are also used to evaluate the intensity and magnitude of the paloevents.

Finally, starting from the developed magnitude-distance correlations, a preliminary definition of a peak acceleration threshold for soil liquefaction are proposed in this study. Liquefaction exclusion criteria, based on peak ground acceleration (PGA) threshold value, are often included in seismic codes and recommendations. EC8 provides a limit for the acceleration at the site surface equal or larger than 0.15g for the occurrence of liquefaction. In Italy, specific verifications are not required by the Italian Building Code (NTC18) whenever the design acceleration on the ground surface is lower than 0.1g. The values herein computed by using different GMPEs ranges from 0.004g to 0.015g. Therefore, the PGA threshold value is an order of magnitude lower than the values in EC8 and NTC18. It is important to highlight the huge uncertainty in the preliminary estimate carried out in this study due to the use of GMPEs.

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# ANNEX

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| | EARTHQUAKES PARAMETERS | | | | | | | | | LIQUEFIED SITE PARAMETERS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Country** | **Date** | **Location** | **Latitude** | **Longitude** | **M** | **Type** | **$I_0$ (MCS)** | **Depth [km]** | **Latitude** | **Longitude** | **Liquefied site** | **Repic [km]** | **Ripo [km]** | **Liquefaction Type** |
| 1 | Italy | 1117.01.03 | Verona Area | 45,267 | 11,015 | 6,52 | $M_w$ | 9 | | 45,434 | 12,339 | Venezia | 105,14 | | Water Ejection |
| 2 | Italy | 1169.02.04 | South-Eastern Sicily | 37,215 | 14,949 | 6,5 | $M_w$ | 10 | | 37,38 | 15,05 | Catania | 20,41 | | B1 |
| 3 | Italy | 1169.02.04 | South-Eastern Sicily | 37,215 | 14,949 | 6,5 | $M_w$ | 10 | | 37,082 | 15,285 | Siracusa | 33,26 | | B1, C2 |
| 4 | Italy | 1169.02.04 | South-Eastern Sicily | 37,215 | 14,949 | 6,5 | $M_w$ | 10 | | 37,284 | 14,998 | Lentini | 8,82 | | C2 |
| 5 | Italy | 1169.02.04 | South-Eastern Sicily | 37,215 | 14,949 | 6,5 | $M_w$ | 10 | | 37,07 | 15 | Catania/Val di Noto | 16,75 | | C2 |
| 6 | Italy | 1169.02.04 | South-Eastern Sicily | 37,215 | 14,949 | 6,5 | $M_w$ | 10 | | 38,187 | 15,529 | Messina | 119,55 | | B2 |
| 7 | Italy | 1348.01.25 | Carnia | 46,504 | 13,581 | 6,63 | $M_w$ | 9 | | 46,609 | 13,851 | Villach (A) | 23,72 | | Ground fracture Water ejection |
| 8 | Spain | 1431.04.24 | Lefkas Isle | 37,125 | -3,626 | 6,11 | $M_w$ | 8_9 | | 37,19 | -3,54 | | 10,51 | | Unspecified |
| 9 | Spain | 1504.04.05 | Lefkas Isle | 37,598 | -5,725 | 6,03 | $M_w$ | 8 | | 37,46 | -5,64 | Carmona | 17,08 | | Unspecified |
| 10 | Italy | 1505.01.03 | Bologna Area | 44,507 | 11,23 | 5,62 | $M_w$ | 8 | | 44,492 | 11,21 | Zola Predosa | 2,30 | | Liquefaction |
| 11 | Turkey | 1509.09.10 | Thrace | 41,022 | 28,786 | 7,14 | $M_w$ | 10 | | | | Instanbul | 15,00 | | A1 |
| 12 | Turkey | 1509.09.10 | Thrace | 41,022 | 28,786 | 7,14 | $M_w$ | 10 | | | | Pera | 17,00 | | A1 |
| 13 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 39,21 | -8,62 | Almeirim | 37,01 | | Unspecified |
| 14 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 38,98 | -8,8 | Benavente | 11,33 | | Unspecified |
| 15 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 39,23 | -8,68 | Santarem | 35,16 | | Unspecified |
| 16 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 38,72 | -8,68 | Lisboa | 36,27 | | Unspecified |
| 17 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 38,66 | -9,055 | Lavradio | 37,29 | | Unspecified |
| 18 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 38,52 | -8,89 | Setubal | 51,40 | | Unspecified |
| 19 | Portugal | 1531.01.26 | Lisboa | 38,981 | -8,931 | 6,47 | $M_w$ | 9 | | 38,37 | -8,51 | Alcacer do Sal | 77,17 | | Unspecified |
| 20 | Italy | 1542.06.13 | Mugello | 44,006 | 11,385 | 6,02 | $M_w$ | 9 | | 43,956 | 11,385 | Borgo S. Lorenzo | 5,56 | | Water Ejection |
| 21 | Italy | 1542.12.10 | South-Eastern Sicily | 37,215 | 14,944 | 6,68 | $M_w$ | 10 | | 37,231 | 15,221 | Augusta | 24,60 | | A |
| 22 | Italy | 1542.12.10 | South-Eastern Sicily | 37,215 | 14,944 | 6,68 | $M_w$ | 10 | | 37,082 | 15,285 | Siracusa | 33,66 | | A |
| 23 | Italy | 1545.06.09 | Val di Taro | 44,473 | 9,825 | 5,38 | $M_w$ | 7_8 | | 44,376 | 9,878 | Pontremoli | 11,58 | | Ground fracture Water ejection Sand Boils |
| 24 | Italy | 1561.08.19 | Vallo di Diano | 40,563 | 15,505 | 6,72 | $M_w$ | 10 | | 40,753 | 15,486 | Muro Lucano | 21,19 | | Ground fracture Sand Boils |
| 25 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,865 | 11,685 | Boara | 6,19 | | Ground cracks Water ejection |
| 26 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,838 | 11,612 | Ferrara | 2,22 | | Fracture with gas emission |
| 27 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,955 | 11,435 | Ficarolo- Ficardo | 21,29 | | Ground cracks water sand ejection |
| 28 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,808 | 11,692 | Ferrara- Giara del Po | 5,06 | | Ground cracks water sand ejection |
| 29 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,82 | 11,67 | Ferrara- La Punta | 3,03 | | Sand water ejection |
| 30 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,83 | 11,63 | Ferrara- Polesino San Giovanni Battista | 0,69 | | Ground cracks water sand ejection |
| 31 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,82 | 11,625 | Ferrara - Polesino San Giorgio | 0,71 | | Ground cracks water sand ejection |
| 32 | Italy | 1570.11.17 | Ferrara Area | 44,824 | 11,632 | 5,44 | $M_w$ | 7_8 | | 44,795 | 11,62 | Ferrara- Torre della Fossa | 3,36 | | Ground cracks water sand ejection |
| 33 | Italy | 1624.03.18 | Argenta | 44,642 | 11,848 | 5,43 | $M_w$ | 7_8 | | 44,617 | 11,836 | Argenta | 2,94 | | Ground cracks water sand ejection |
| 34 | Italy | 1624.03.18 | Argenta | 44,642 | 11,848 | 5,43 | $M_w$ | 7_8 | | 44,838 | 11,612 | Ferrara | 28,69 | | Ground cracks water sand ejection sand boils |
| 35 | Italy | 1624.10.03 | Monti Iblei Settentrionali | 37,27 | 14,742 | 5,56 | $M_w$ | 8 | | 37,326 | 14,745 | Palagonia | 6,23 | | C2 |
| 36 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | | 41,866 | 15,35 | Lesina | 14,36 | | C |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,85 | 15,284 | Ripalta | 13,46 | C |
| 38 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,917 | 15,283 | Serracapriola- Foci del Fortore | 20,61 | Liquefaction ground cracks water sand emission |
| 39 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,833 | 15,233 | Serracapriola- Serra S. Agata (Valle d. Fortore) | 13,99 | Ground cracks water sand ejection |
| 40 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,361 | 15,309 | Troia | 41,91 | water sand ejection |
| 41 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,783 | 15,217 | La Taverna | 11,56 | Sand boils |
| 42 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,739 | 15,261 | San Paolo Civitate | 6,73 | Ground cracks sand boils |
| 43 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,682 | 15,38 | San Severo | 6,88 | Ground cracks water ejection |
| 44 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 41,688 | 15,292 | Torremaggiore | 6,85 | Ground cracks water sand ejection |
| 45 | Italy | 1627.07.30 | Capitanata | 41,737 | 15,342 | 6,66 | $M_w$ | 10 | 42 | 14,991 | Termoli | 41,24 | Water Ejection |
| 46 | Italy | 1638.03.27 | Central Calabria | 39,048 | 16,289 | 7,09 | $M_w$ | 11 | 38,664 | 16,284 | San Nicola da Carissa | 42,71 | Water ejection subsidence |
| 47 | Italy | 1638.03.27 | Central Calabria | 39,048 | 16,289 | 7,09 | $M_w$ | 11 | 38,9 | 16,25 | Nicastro-Sanbiase, Valle del F. Lamato | 16,80 | water sand ejection |
| 48 | Italy | 1638.03.27 | Central Calabria | 39,048 | 16,289 | 7,09 | $M_w$ | 11 | 38,933 | 16,25 | Nicastro- Sambiase, Sant'Eufemia | 13,23 | sand boils subsidence |
| 49 | Turkey | 1653.02.22 | Aydin | 37,86 | 27,8 | 6,72 | $M_w$ | 10 | | | Guzelhisar | 7,00 | B1 |
| 50 | Italy | 1661.03.22 | Appennino Forlivese | 44,021 | 11,898 | 6,05 | $M_w$ | 9 | 44,063 | 11,848 | Rocca San Casciano | 6,15 | Ground cracks water ejectin sand boils |
| 51 | Italy | 1688.06.05 | Sannio | 41,283 | 14,561 | 7,06 | $M_w$ | 11 | 41,266 | 14,9 | S. Giorgio la Molara | 28,40 | B, C |
| 52 | Italy | 1688.06.05 | Sannio | 41,283 | 14,561 | 7,06 | $M_w$ | 11 | 41,328 | 14,331 | Alife | 19,86 | Ground cracks water ejection |
| 53 | Italy | 1688.06.05 | Sannio | 41,283 | 14,561 | 7,06 | $M_w$ | 11 | 41,358 | 14,375 | Piedimonte Matese | 17,64 | Ground cracks water ejection |
| 54 | Italy | 1688.06.05 | Sannio | 41,283 | 14,561 | 7,06 | $M_w$ | 11 | 41,287 | 14,559 | Cerreto Sannita | 0,48 | Water ejection |
| 55 | Italy | 1688.06.05 | Sannio | 41,283 | 14,561 | 7,06 | $M_w$ | 11 | 41,131 | 14,777 | Benevento | 24,75 | Unspecified |
| 56 | Turkey | 1688.07.10 | Izmir | 38,38 | 27,17 | 6,82 | $M_w$ | 10 | | | Izmir | 6,00 | A1, A3 |
| 57 | Turkey | 1688.07.10 | Izmir | 38,38 | 27,17 | 6,82 | $M_w$ | 10 | | | Sancak Burnu | 12,00 | A3 |
| 58 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,266 | 14,69 | Mineo | 31,86 | B1 |
| 59 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 36,94 | 15,023 | Noto Antica | 22,26 | B1 |
| 60 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 36,9 | 15,06 | Scala | 27,02 | B1 |
| 61 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,156 | 15,027 | Sortino | 2,17 | B1, B2 |
| 62 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,082 | 15,285 | Siracusa | 24,97 | B1, C2, A, C1 |
| 63 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,566 | 14,902 | Paternò | 48,39 | B3 |
| 64 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,179 | 15,128 | Melilli | 11,08 | C1 |
| 65 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,221 | 15,221 | Augusta | 20,52 | C1 |
| 66 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 38,187 | 15,529 | Messina | 125,00 | C1, B1 |
| 67 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,384 | 14,368 | Piazza Armerina | 63,22 | C2 |
| 68 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 38,177 | 15,529 | Messina | 123,97 | C2 |
| 69 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,231 | 15,221 | Augusta | 21,03 | C2 |
| 70 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 36,908 | 15,135 | Avola | 27,99 | A |
| 71 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,757 | 15,159 | Mascali | 69,83 | A, C2 |
| 72 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,284 | 14,998 | Lentini | 16,07 | B1, A, C2 |
| 73 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,502 | 15,087 | Catania | 40,79 | B1, A, C2 |
| 74 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,502 | 15,087 | Piana di Catania | 40,79 | C2, A |
| 75 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,07 | 15 | Val di Noto | 7,87 | B2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 76 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,097 | 14,937 | Cassaro | 8,26 | Ground cracks sand boils |
| 77 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 38,121 | 14,79 | Naso | 110,87 | Unspecified |
| 78 | Italy | 1693.01.11 | South-Eastern Sicily | 37,14 | 15,013 | 7,32 | $M_w$ | 11 | 37,12 | 14,94 | Ferla | 6,84 | Sand boils |
| 79 | Italy | 1703.02.02 | L'Aquila Area | 42,434 | 13,292 | 6,67 | $M_w$ | 10 | 42,524 | 13,24 | Montereale | 10,88 | Water ejection |
| 80 | Italy | 1703.02.02 | L'Aquila Area | 42,434 | 13,292 | 6,67 | $M_w$ | 10 | 42,437 | 13,295 | Pizzoli | 0,41 | water sand ejection |
| 81 | Turkey | 1719.05.25 | Izmit | 40,66 | 29,58 | 6,75 | $M_w$ | 10 | | | Izmit | 33,00 | B1 |
| 82 | Italy | 1731.03.20 | Tavoliere delle Puglie | 41,274 | 15,757 | 6,33 | $M_w$ | 9 | 41,464 | 15,544 | Foggia | 27,62 | Water ejection sand boils |
| 83 | Turkey | 1739.04.04 | Izmir | 38,5 | 26,9 | 6,78 | $M_w$ | 9 | | | Old Foca | 22,00 | A1 |
| 84 | Turkey | 1739.04.04 | Izmir | 38,5 | 26,9 | 6,78 | $M_w$ | 9 | | | Gediz r. (Delta) | 14,00 | A3 |
| 85 | Spain | 1751.03.04 | Velez Rubio | 37,65 | -2,066 | 5,08 | $M_w$ | 6_7 | 37,64 | -2,07 | Velez Rubio | 1,17 | Unspecified |
| 86 | Italy | 1753.03.09 | Valle del Chisone | 44,941 | 7,181 | 5,16 | $M_w$ | 6_7 | 45,135 | 7,046 | Susa | 24,05 | Ground cracks water ejection |
| 87 | Italy | 1753.03.09 | Valle del Chisone | 44,941 | 7,181 | 5,16 | $M_w$ | 6_7 | 44,885 | 7,332 | Pinerolo | 13,43 | Ground cracks water ejection |
| 88 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 37,31 | -8,79 | Aljezur | 155,46 | Unspecified |
| 89 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 37,1 | -8,67 | Lagos | 162,83 | Unspecified |
| 90 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,46 | -8,19 | Abrantes | 339,97 | Unspecified |
| 91 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,98 | -8,8 | Benavente | 265,90 | Unspecified |
| 92 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,96 | -8,52 | Coruche | 278,66 | Unspecified |
| 93 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,54 | -8,27 | Aldeia do Mato | 343,10 | Unspecified |
| 94 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,98 | -8,28 | Couço | 293,87 | Unspecified |
| 95 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,65 | -8,57 | Caissa | 339,44 | Unspecified |
| 96 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,76 | -8,45 | Freixianda | 355,20 | Unspecified |
| 97 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,705 | -9,144 | C.Sodrè | 223,93 | Unspecified |
| 98 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,708 | -9,145 | Largo de S.Paulo | 224,16 | Unspecified |
| 99 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,705 | -9,14 | Av. Das Ribeiras das Naus | 224,11 | Unspecified |
| 100 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,707 | -9,136 | Terreiro do Paço | 224,49 | Unspecified |
| 101 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,702 | -9,17 | Alcantara | 222,44 | Unspecified |
| 102 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,728 | -9,109 | Xabregas | 227,72 | Unspecified |
| 103 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,79 | -9,104 | Sacavém | 233,77 | Unspecified |
| 104 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,701 | -9,25 | Cruz Quebrada | 218,73 | Unspecified |
| 105 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,69 | -9,42 | Cascais | 210,55 | Unspecified |
| 106 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,67 | -9,23 | Trafaria | 216,67 | Unspecified |
| 107 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,83 | -9,17 | Loures | 234,62 | Unspecified |
| 108 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,52 | -8,89 | Setùbal | 220,50 | Unspecified |
| 109 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,51 | -9,01 | Azeitao | 213,01 | Unspecified |
| 110 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 38,94 | -9,33 | Mafra | 238,92 | Unspecified |
| 111 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,06 | -9,2 | Runa | 255,86 | Unspecified |
| 112 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,54 | -8,97 | Alcobaça | 312,50 | Unspecified |
| 113 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,65 | -8,82 | Batalha | 329,17 | Unspecified |
| 114 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,7 | -8,83 | Azoia | 333,76 | Unspecified |
| 115 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,75 | -8,84 | Barosa | 338,37 | Unspecified |
| 116 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,89 | -8,88 | Coimbrao | 351,04 | Unspecified |
| 117 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,84 | -8,87 | Monte Real | 346,33 | Unspecified |
| 118 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,89 | -8,83 | Monte Redondo | 352,81 | Unspecified |
| 119 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | 39,84 | -8,83 | Souto da Carpalhosa | 347,77 | Unspecified |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 120 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 39,85 | -8,95 | Vieira | 344,55 | | Unspecified |
| 121 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 39,75 | -8,92 | Marinha Grande | 335,45 | | Unspecified |
| 122 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 39,91 | -8,69 | Pombal (Juncal) | 360,00 | | Unspecified |
| 123 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 39,6 | -8,81 | Porto de Mòs | 324,62 | | Unspecified |
| 124 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,1 | -8,63 | Vila Nova de Anços | 381,22 | | Unspecified |
| 125 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,16 | -8,75 | Maiorca | 382,98 | | Unspecified |
| 126 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,44 | -8,75 | Lagoa de Mira | 411,63 | | Unspecified |
| 127 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,44 | -8,72 | Lagoa de Portomar | 412,60 | | Unspecified |
| 128 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,17 | -8,68 | Colegiado | 386,44 | | Unspecified |
| 129 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,17 | -8,68 | Campo de Cima | 386,44 | | Unspecified |
| 130 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,17 | -8,68 | S.Martinho | 386,44 | | Unspecified |
| 131 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,12 | -8,68 | Vila Nova de Barca | 381,40 | | Unspecified |
| 132 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,15 | -8,65 | Alfarelos | 385,50 | | Unspecified |
| 133 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,15 | -8,65 | Gestaria | 385,50 | | Unspecified |
| 134 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,1 | -8,63 | Vila Nova de Anços | 381,22 | | Unspecified |
| 135 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,63 | -8,47 | Lamas do Vouga (Vila Verde) | 440,38 | | Unspecified |
| 136 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,64 | -8,66 | Aveiro (Vera Cruz) | 435,10 | | Unspecified |
| 137 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 41,04 | -8,27 | Castelo de Paiva (Bairros) | 488,88 | | Unspecified |
| 138 | Portugal | 1755.11.01 | Epicenter Offshore | 37 | -10,5 | 8,5 | $M_w$ | 10 | | 40,92 | -8,54 | Feira | 467,76 | | Unspecified |
| 139 | Croatia | 1757.06.27 | Virovitica | 45,800 | 17,400 | 6,42 | $M_w$ | 9 | | 45,832 | 17,385 | Virovitica | 3,75 | | Sand boils Ground cracks |
| 140 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,752 | 18,138 | Komaron_Turtle's_tail | 12,68 | 14,78 | Liquefaction lateral_spreading |
| 141 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,699 | 17,636 | Révfalu | 49,36 | 49,94 | sand boils |
| 142 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,952 | 17,648 | Csallóköz (Žitný ostrov) | 48,43 | 49,02 | sand boils |
| 143 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,812 | 17,863 | Nemesolcsa (Zemianska Olca) | 30,40 | 31,33 | sand boils |
| 144 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,725 | 17,883 | Nagykeszi (Vel’ké Kosihy) | 30,92 | 31,84 | sand boils |
| 145 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,819 | 17,984 | Megyercs (Calovec) | 21,33 | 22,65 | sand boils |
| 146 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,752 | 17,820 | Kolozsnéma (Klížska Nemá) | 34,52 | 35,35 | sand boils |
| 147 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,924 | 18,750 | Kiskeszi (Malé Kosihy) | 37,51 | 38,28 | sand boils |
| 148 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,820 | 18,041 | Keszegfalva (Kamenicná) | 17,06 | 18,68 | sand boils |
| 149 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,918 | 17,995 | Guta (Kolárovo) | 22,94 | 24,16 | sand boils |
| 150 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,805 | 17,921 | Ekel (Okolicˇná na Ostrove) | 26,10 | 27,19 | sand boils |
| 151 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,769 | 17,769 | Csicsó (Cícov) | 37,87 | 38,62 | sand boils |
| 152 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,772 | 17,972 | Csallóközaranyos (Zlatná na Ostove) | 22,97 | 24,19 | sand boils |
| 153 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,764 | 18,044 | Örsujfalu (Nová Stráž) | 18,10 | 19,63 | sand boils |
| 154 | Hungary | 1763.06.28 | Komaron | 47,825 | 18,269 | 5,7 | $M_w$ | 8_9 | 7,6 | 47,822 | 18,354 | Madar (Modrany) | 6,33 | 9,89 | sand boils |
| 155 | Turkey | 1766.05.22 | Instanbul | 40,8 | 29,1 | 6,76 | $M_w$ | 9 | | | | Galata Coast | 28,00 | | A3, B3 |
| 156 | Greece | 1767.07.11 | Lyxouri | 38,3 | 20,4 | 6,65 | $M_w$ | 10 | | | | Argostoli | 15,00 | | B2 |
| 157 | Greece | 1767.07.11 | Lyxouri | 38,3 | 20,4 | 6,65 | $M_w$ | 10 | | | | Paliki Peninsula | 10,00 | | C |
| 158 | Turkey | 1778.07.03 | Izmir | 38,4 | 26,8 | 6,55 | $M_w$ | 9 | | | | Izmir | 30,00 | | A1 |
| 159 | Turkey | 1778.07.03 | Izmir | 38,4 | 26,8 | 6,55 | $M_w$ | 9 | | | | Urla | 4,00 | | A3 |
| 160 | Italy | 1780.03.28 | North-Eastern Sicily | 37,866 | 15,316 | 5,52 | $M_w$ | 7_8 | | 38,02 | 15,38 | Fiumedinisi | 18,03 | | C2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 161 | Italy | 1781.04.04 | Faenza Area | 44,251 | 11,798 | 6,12 | $M_w$ | 9_10 | 44,319 | 11,801 | Castel Bolognese | 7,57 | Ground cracks water ejection sand boils |
| 162 | Italy | 1781.04.04 | Faenza Area | 44,251 | 11,798 | 6,12 | $M_w$ | 9_10 | 44,276 | 11,805 | Pergola | 2,84 | Ground cracks sand boils |
| 163 | Italy | 1781.04.04 | Faenza Area | 44,251 | 11,798 | 6,12 | $M_w$ | 9_10 | 44,25 | 11,81 | Montefortino- Quartolo | 0,96 | Ground cracks |
| 164 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,258 | 15,611 | Ganzirri | 31,64 | B1 |
| 165 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,187 | 15,529 | Messina | 40,42 | B1, B2 |
| 166 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,187 | 15,549 | Messina | 38,76 | C2 |
| 167 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,233 | 15,916 | Pedavoli [ 2 ] | 8,54 | A1, A3-5 |
| 168 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,325 | 15,944 | River S.Biase [Fiumara Boscaino] | 3,85 | A4-5 |
| 169 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,404 | 16,094 | Cinquefrondi (Ventriconi) | 16,08 | A5 |
| 170 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,083 | 16,083 | Caraffa del Bianco [ 1 ] | 25,77 | A1, A4-5 |
| 171 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,333 | 16,033 | Galatoni *[1] | 6,80 | A1, A4-5 |
| 172 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,266 | 15,65 | Torre Faro | 28,15 | A1, A4-5 |
| 173 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,667 | 16,1 | Monteleone [Vibo Valentia] [ 1 ] | 42,68 | A1, A4-5 |
| 174 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,35 | 16,083 | Casalnuovo [Cittanova] | 11,49 | A1, A4-5, B |
| 175 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,616 | 16,183 | River Porcione*[R.Marepotamo] [ 1 ] | 40,04 | A1, B, E |
| 176 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,3 | 15,983 | Tresilico | 1,18 | A1-2, B |
| 177 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,283 | 15,916 | Trodi [ 1 ] | 4,96 | A2, D |
| 178 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,283 | 15,804 | Bagnara Calabra* [ 1 ] | 14,58 | B |
| 179 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,916 | 16,583 | Catanzaro [ 1 ] | 87,06 | B |
| 180 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,443 | 15,95 | Drosi*(C. del Crocifisso) | 16,33 | B |
| 181 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,016 | 15,733 | Laganadi [ 1 ] | 37,50 | B |
| 182 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,833 | 16,516 | San Floro* [ 1 ] | 76,22 | B |
| 183 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,583 | 16,333 | Serra S. Bruno [ 1 ] | 44,86 | B |
| 184 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,6 | 16,233 | Soriano Calabro [ 1 ] | 40,75 | C |
| 185 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,555 | 16,19 | Acquaro | 34,51 | Ground cracks water ejection sand boils |
| 186 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,511 | 16,069 | Oppido Mamertina- Borello (Fondaco di) | 25,32 | Ground cracks water ejection sand boils |
| 187 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,184 | 15,724 | Calanna | 24,90 | Ground cracks sand boils |
| 188 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,317 | 15,933 | Castellace Vecchio | 3,92 | sand boils subsidence |
| 189 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,418 | 16,095 | Cinque Frondi | 17,32 | Ground cracks water ejection sand boils |
| 190 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,6 | 15,867 | Joppolo- Coccorino | 34,88 | Ground cracks |
| 191 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,274 | 15,928 | Cosoleto | 4,47 | Ground cracks sand boils |
| 192 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,567 | 16,2 | Dasà | 36,10 | Ground cracks water ejection sand boils |
| 193 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,233 | 15,917 | Delianuova- Paracorio | 8,49 | Ground cracks water ejection sand boils |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,211 | 15,692 | San Nicola- Fiumara | 26,10 | Ground cracks water ejection sand boils |
| 195 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,171 | 15,663 | Reggio Calabria- Gallico | 30,26 | Sand boils |
| 196 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,592 | 16,217 | Gerocarne- Soriano Calabro | 39,24 | Ground cracks water sand ejection |
| 197 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,431 | 15,898 | Gioia Tauro | 16,17 | Subisdence water ejection |
| 198 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,583 | 15,9 | Joppolo | 32,39 | Ground cracks water sand ejection |
| 199 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,497 | 16,081 | Laureana di Borrello | 24,26 | Ground cracks water sand ejection |
| 200 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,267 | 15,95 | Santa Cristina D'Aspromonte- Lubrichi | 3,77 | Ground cracks water ejection sand boils subsidence |
| 201 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,859 | 16,365 | Maida | 71,32 | Ground cracks water ejection sand boils |
| 202 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,441 | 16,097 | Maropati | 19,47 | Sand boils |
| 203 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,554 | 15,938 | Nicotera | 28,72 | Water ejection |
| 204 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,289 | 15,984 | Oppido Mamertina | 1,51 | Ground cracks water sand ejection |
| 205 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,3 | 15,95 | Oppido Mamertina- Contrada Nicolella | 1,78 | Sand boils |
| 206 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,288 | 15,972 | Oppido Mamertina- Fondaco Tricuccio | 1,02 | water sand ejection |
| 207 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,359 | 15,848 | Palmi | 12,68 | Sand boils |
| 208 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,407 | 16,074 | Polistena | 15,23 | Ground cracks water ejection sand boils subsidence |
| 209 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,35 | 16,017 | Taurianova- Radicena | 7,18 | Ground cracks water ejection sand boils subsidence |
| 210 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,119 | 15,653 | Reggio Calabria | 34,05 | Sand boils |
| 211 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,617 | 16,15 | Francica-Rise del R. Mesima | 38,89 | Water ejection |
| 212 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,489 | 15,973 | Rosarno | 21,36 | sand boils subsidence |
| 213 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 39,339 | 16,145 | San Fili | 116,89 | Ground cracks sand boils |
| 214 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 39,307 | 16,049 | San Lucido | 112,55 | Sand boils |
| 215 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,286 | 15,9 | San Procopio (La Conturella) | 6,23 | Water ejection |
| 216 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,282 | 15,888 | San Procopio | 7,35 | Ground cracks sand boils |
| 217 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,292 | 15,903 | San Procopio- Goletta | 5,88 | Unspecified |
| 218 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,278 | 15,889 | San Procopio (Bombardara) | 7,38 | Water ejection |
| 219 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,324 | 15,888 | Seminara- Sant'Anna di Seminara | 7,76 | Water ejection subsidence |
| 220 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,256 | 15,97 | Santa Cristina D'Aspromonte | 4,56 | Ground cracks sand boils |
| 221 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,25 | 15,933 | Scido- Santa Giorgia | 6,15 | Ground cracks sand boils |
| 222 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,245 | 15,933 | Scido | 6,63 | Ground cracks sand boils subsidence |
| 223 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,333 | 16,016 | Terranova Sappo Minulo- Scrofario | 5,67 | Sand boils |
| 224 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,336 | 15,871 | Seminara- Sant'Anna di Seminara | 9,67 | Water ejection subsidence |
| 225 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,283 | 15,933 | Cosoleto- Sitizano | 3,59 | Unspecified |
| 226 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,321 | 16,007 | Terranova Sappio Minulo | 4,19 | Sand boils |
| 227 | Italy | 1783.02.05 | Southern Calabria | 38,297 | 15,97 | 7,1 | $M_w$ | 11 | 38,315 | 15,983 | Varapodio | 2,30 | Sand boils |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,556 | 16,189 | Acquaro | 2,87 | | Ground cracks sand boils |
| 229 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,119 | 15,653 | Reggio Calabria | 70,10 | | sand boils subsidence |
| 230 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,598 | 16,23 | Soriano Calabro | 3,22 | | Water ejection |
| 231 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,497 | 16,081 | Laureana di Borrello | 13,94 | | Sand boils |
| 232 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,651 | 16,298 | Vallelonga | 11,55 | | Sand boils |
| 233 | Italy | 1783.02.07 | Calabria | 38,58 | 16,201 | 6,74 | $M_w$ | 10_11 | | 38,565 | 16,196 | Dasà | 1,72 | | Ground cracks sand boils |
| 234 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,833 | 16,516 | Borgia | 6,99 | | A1-2, A4-5 |
| 235 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,833 | 16,267 | Acconia | 17,89 | | Ground cracks sand boils |
| 236 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,826 | 16,311 | Acconia- Curinga | 14,02 | | Ground cracks sand boils |
| 237 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,833 | 16,25 | Feroleto Antico- Fondaco del Fico | 19,30 | | Water ejection |
| 238 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,98 | 16,206 | Gizzeria | 31,14 | | Water ejection |
| 239 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,849 | 16,377 | Jacurso | 10,37 | | Ground cracks sand boils |
| 240 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,497 | 16,081 | Laureana di Borrello | 46,19 | | Sand boils |
| 241 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,859 | 16,365 | Maida | 11,89 | | Ground cracks sand boils |
| 242 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,75 | 16,514 | Montauro | 5,83 | | Sand boils |
| 243 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,718 | 16,288 | Monterosso Calabro | 16,99 | | Ground cracks sand boils |
| 244 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,833 | 16,583 | Borgia- Pantano di Teremola | 11,61 | | Ground cracks sand boils |
| 245 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,75 | 16,317 | Polia-Poliolo | 13,33 | | Sand boils |
| 246 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,817 | 16,598 | Borgia-Roccelletta | 12,15 | | Sand boils |
| 247 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,933 | 16,25 | Sant'Eufemia | 24,79 | | Sand boils |
| 248 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,846 | 16,345 | San Pietro a Maida | 12,34 | | Sand boils |
| 249 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,781 | 16,518 | Squillace | 4,70 | | Water ejection |
| 250 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,893 | 16,404 | Maida- Vena di Maida | 13,09 | | Ground cracks sand boils |
| 251 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,675 | 16,101 | Vibo Valentia | 33,79 | | Water ejection |
| 252 | Italy | 1783.03.28 | Central Calabria | 38,785 | 16,464 | 7,03 | $M_w$ | 11 | | 38,84 | 16,414 | Cortale | 7,50 | | Ground cracks sand boils |
| 253 | Hungary | 1783.04.22 | Komaron | 47,668 | 18,036 | 5,35 | $M_w$ | 5 | 11,5 | 47,752 | 18,138 | Komaron | 12,11 | 16,70 | sand boils ground cracks |
| 254 | Hungary | 1783.04.22 | Komaron | 47,668 | 18,036 | 5,35 | $M_w$ | 5 | 11,5 | 47,747 | 18,491 | Labatlan | 35,17 | 37,00 | sand boils ground cracks |
| 255 | Italy | 1785.10.09 | Monti Reatini | 42,536 | 12,788 | 5,76 | $M_w$ | 8_9 | | 42,53 | 12,763 | S.Nicolo' | 2,15 | | A1, A4-5 |
| 256 | Italy | 1785.10.09 | Monti Reatini | 42,536 | 12,788 | 5,76 | $M_w$ | 8_9 | | 42,535 | 12,76 | Terni- Piediluco | 2,30 | | Ground cracks water ejection |
| 257 | Italy | 1786.12.25 | Rimini Area | 43,991 | 12,565 | 5,66 | $M_w$ | 8 | | 44,059 | 12,569 | Rimini | 7,57 | | Unspecified |
| 258 | Italy | 1789.09.30 | Alta Val Tiberina | 43,51 | 12,217 | 5,89 | $M_w$ | 9 | | 42,32 | 12,622 | Selci | 136,41 | | Ground cracks sand boils |
| 259 | Greece | 1791.11.02 | Zakynthos Isle | 37,8 | 21 | 6,78 | $M_w$ | 10 | | | | Zakynthos | 10,00 | | B1 |
| 260 | Italy | 1802.05.12 | Valle dell'Oglio | 45,424 | 9,839 | 5,6 | $M_w$ | 8 | | 45,369 | 9,827 | Ticengo | 6,19 | | Ground crack |
| 261 | Italy | 1802.05.12 | Valle dell'Oglio | 45,424 | 9,839 | 5,6 | $M_w$ | 8 | | 45,399 | 9,874 | Soncino | 3,90 | | Ground cracks |
| 262 | Romania | 1802.10.26 | Vrancea | 45,700 | 26,600 | 7,9 | $M_w$ | 10 | 150 | 44,440 | 26,120 | Coltea_tower_(Bucharest) | 145,13 | 208,72 | sand boil ground cracks |
| 263 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 41,483 | 14,466 | Boiano | 2,00 | | Unspecified |
| 264 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 40,9 | 15,433 | Calitri (Vallone dei monaci) [ 2 ] | 104,38 | | Unspecified |
| 265 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 41,527 | 14,389 | Cantalupo nel Sannio | 7,69 | | Ground cracks water ejection |
| 266 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 41,646 | 14,643 | Montagano | 21,48 | | Ground cracks water ejection |
| 267 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 41,55 | 14,34 | Bosso (Busso) | 12,47 | | Ground cracks sand boils |
| 268 | Italy | 1805.07.26 | Molise | 41,5 | 14,474 | 6,68 | $M_w$ | 10 | | 41,349 | 14,669 | Morcone | 23,38 | | Water ejection |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 269 | Spain | 1806.10.27 | Pinos Puerte- Granada | 37,209 | -3,717 | 5,16 | $M_w$ | 7 | | 37,22 | -3,74 | | 2,38 | | Unspecified |
| 270 | Hungary | 1810.01.14 | Mor | 47,318 | 18,186 | 5,48 | $M_w$ | 5 | 18 | 47,322 | 18,091 | Bakonycsernye | 7,19 | 19,38 | sand boils ground cracks |
| 271 | Hungary | 1810.01.14 | Mor | 47,318 | 18,186 | 5,48 | $M_w$ | 5 | 18 | 47,361 | 18,111 | Nagyveleg | 7,43 | 19,47 | sand boils ground cracks |
| 272 | Greece | 1817.08.23 | Aeghio | 38,244 | 22,078 | 6,6 | $M_w$ | 9 | | 38,264 | 22,108 | Cape Aliki | 3,44 | | Subsidence mud volcanoes |
| 273 | Italy | 1818.02.20 | Catania Area | 37,603 | 15,14 | 6,28 | $M_w$ | 9_10 | | 37,66 | 15,19 | Pozzillo | 7,72 | | B1 |
| 274 | Italy | 1818.02.20 | Catania Area | 37,603 | 15,14 | 6,28 | $M_w$ | 9_10 | | 37,35 | 15,07 | Ramondetta | 28,81 | | A |
| 275 | Italy | 1818.02.20 | Catania Area | 37,603 | 15,14 | 6,28 | $M_w$ | 9_10 | | 37,4 | 15,08 | Paraspolo (near R.Simeto) | 23,19 | | A, B1, C2 |
| 276 | Italy | 1818.02.20 | Catania Area | 37,603 | 15,14 | 6,28 | $M_w$ | 9_10 | | 37,566 | 14,902 | Paternò neighbour | 21,38 | | A, C2 |
| 277 | Greece | 1820.02.21 | Lefkas Isle | 38,834 | 20,708 | 6,4 | $M_w$ | 9 | | | | Lefkada Square | 9,00 | | A3 |
| 278 | Italy | 1823.03.05 | Northern Sicily | 38,185 | 14,344 | 5,81 | $M_w$ | 8 | | 37,984 | 13,698 | Termini Imerese | 60,81 | | Sand boils |
| 279 | Italy | 1823.03.05 | Northern Sicily | 38,185 | 14,344 | 5,81 | $M_w$ | 8 | | 37,496 | 14,1 | Caltanissetta- Terra Pelata | 79,58 | | Ground crack |
| 280 | Italy | 1826.02.01 | Potenza Area | 40,52 | 15,726 | 5,74 | $M_w$ | 8 | | 40,582 | 15,674 | Tito | 8,18 | | Water ejection |
| 281 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,11 | -0,72 | San Fulgencio | 3,06 | | Unspecified |
| 282 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,13 | -0,77 | Dolores | 5,32 | | Unspecified |
| 283 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,1 | -0,73 | Daya Vieja | 1,65 | | Unspecified |
| 284 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,1 | -0,79 | Calle Donadores | 4,49 | | Unspecified |
| 285 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,11 | -0,85 | Pasajes Las Carolinas | 9,85 | | Unspecified |
| 286 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,12 | -0,87 | Calossa | 11,84 | | Unspecified |
| 287 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,11 | -0,91 | Orihuela | 14,99 | | Unspecified |
| 288 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,08 | -0,94 | Orihuela | 17,44 | | Unspecified |
| 289 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,15 | -0,96 | Benferri | 20,37 | | Unspecified |
| 290 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,15 | -0,9 | Calle La Rambleta | 15,53 | | Unspecified |
| 291 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,17 | -0,9 | Camino Del Espartal | 16,63 | | Unspecified |
| 292 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,2 | -0,84 | Partida Atalayas Gp. | 15,17 | | Unspecified |
| 293 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,17 | -0,81 | Via Pista | 10,94 | | Unspecified |
| 294 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,24 | -0,82 | Vìa Pista | 18,26 | | Unspecified |
| 295 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,26 | -0,7 | Elche | 19,46 | | Unspecified |
| 296 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,08 | -0,65 | Guardamar | 8,02 | | Unspecified |
| 297 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,08 | -0,72 | Benijofar | 2,04 | | Unspecified |
| 298 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,07 | -0,74 | Lugar Diseminados | 2,00 | | Unspecified |
| 299 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,08 | -0,82 | Orihuela | 6,97 | | Unspecified |
| 300 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,07 | -0,89 | Correntias Bajas | 13,20 | | Unspecified |
| 301 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,07 | -0,86 | Diseminado Diseminados | 10,61 | | Unspecified |
| 302 | Spain | 1829.03.21 | Torrevieja | 38,088 | -0,741 | 6,25 | $M_w$ | 10 | | 38,07 | -0,9 | Azarbeta de Las Vinas | 14,06 | | Unspecified |
| 303 | Romania | 1829.07.01 | Pishkol't | 47,548 | 22,261 | 5,36 | $M_w$ | 7 | 13 | 47,534 | 22,379 | Dengeleg (Erdengeleg) | 9,03 | 15,83 | sand boils ground cracks |
| 304 | Romania | 1829.07.01 | Pishkol't | 47,548 | 22,261 | 5,36 | $M_w$ | 7 | 13 | 47,514 | 22,335 | Érendréd | 6,75 | 14,65 | sand boils ground cracks |
| 305 | Italy | 1832.01.13 | Valle Umbra | 42,98 | 12,605 | 6,43 | $M_w$ | 10 | | 42,939 | 12,668 | Corvia | 6,86 | | A4-5 |
| 306 | Italy | 1832.01.13 | Valle Umbra | 42,98 | 12,605 | 6,43 | $M_w$ | 10 | | 42,933 | 12,633 | Cantagalli | 5,70 | | A1, A4, D |
| 307 | Italy | 1832.01.13 | Valle Umbra | 42,98 | 12,605 | 6,43 | $M_w$ | 10 | | 42,95 | 12,63 | Foligno- Budino | 3,91 | | Ground cracks sand boils |
| 308 | Italy | 1832.01.13 | Valle Umbra | 42,98 | 12,605 | 6,43 | $M_w$ | 10 | | 42,955 | 12,704 | Foligno | 8,52 | | Water ejection |
| 309 | Italy | 1832.01.13 | Valle Umbra | 42,98 | 12,605 | 6,43 | $M_w$ | 10 | | 44,028 | 11,107 | Luicciana-Cantagallo | 167,90 | | Sand boils |
| 310 | Italy | 1832.03.08 | Crotone Area | 39,079 | 16,919 | 6,65 | $M_w$ | 10 | | 38,961 | 16,803 | Crocchio River (Giardino di C.) | 16,51 | | A1, A3 |
| 311 | Italy | 1832.03.08 | Crotone Area | 39,079 | 16,919 | 6,65 | $M_w$ | 10 | | 38,983 | 16,917 | Cutro- Fiume Targine | 10,68 | | Ground cracks water sand ejection |
| 312 | Italy | 1832.03.08 | Crotone Area | 39,079 | 16,919 | 6,65 | $M_w$ | 10 | | 38,942 | 16,921 | Cutro- Piana di Steccato | 15,24 | | Ground cracks water sand ejection |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 313 | Italy | 1832.03.08 | Crotone Area | 39,079 | 16,919 | 6,65 | $M_w$ | 10 | | 38,968 | 16,783 | Cropani | 17,04 | | Ground cracks sand boils |
| 314 | Italy | 1832.03.08 | Crotone Area | 39,079 | 16,919 | 6,65 | $M_w$ | 10 | | 39,033 | 16,982 | Cutro | 7,47 | | Sand boils |
| 315 | Italy | 1832.03.13 | Reggio Emilia Area | 44,765 | 10,494 | 5,51 | $M_w$ | 7_8 | | 44,8 | 10,33 | San Leonardo ( Parma) | 13,52 | | Ground cracks |
| 316 | Romania | 1834.10.15 | Ermellk | 47,531 | 22,308 | 5,96 | $M_w$ | 9 | 21 | 47,583 | 22,286 | Piskolt (Piscolt) | 6,02 | 21,85 | sand boils ground cracks |
| 317 | Romania | 1834.10.15 | Ermellk | 47,531 | 22,308 | 5,96 | $M_w$ | 9 | 21 | 47,550 | 22,844 | Béltek (Beltiug) | 40,32 | 45,46 | sand boils ground cracks |
| 318 | Romania | 1834.10.15 | Ermellk | 47,531 | 22,308 | 5,96 | $M_w$ | 9 | 21 | 47,514 | 22,335 | Érendréd | 2,81 | 21,19 | sand boils ground cracks |
| 319 | Romania | 1834.10.15 | Ermellk | 47,531 | 22,308 | 5,96 | $M_w$ | 9 | 21 | 47,536 | 22,377 | Érdengeleg | 5,22 | 21,64 | sand boils ground cracks |
| 320 | Italy | 1836.04.25 | Northern Calabria | 39,567 | 16,737 | 6,18 | $M_w$ | 9 | | 39,574 | 16,635 | Rossano | 8,78 | | Ground cracks |
| 321 | Italy | 1836.04.25 | Northern Calabria | 39,567 | 16,737 | 6,18 | $M_w$ | 9 | | 39,617 | 16,633 | Rossano-S. Angelo | 10,51 | | Sand boils |
| 322 | Greece | 1837.03.20 | Poros Isle | 37,421 | 23,326 | 5,99 | $M_w$ | 7 | | 37,501 | 23,454 | Poros port | 14,38 | | Ground cracks |
| 323 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 44,970 | 24,240 | Babeni | 201,59 | 251,27 | sand boils ground cracks |
| 324 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 44,480 | 26,430 | Belciugatu | 136,35 | 202,71 | sand boils ground cracks |
| 325 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 45,500 | 27,500 | Bolboaca | 73,49 | 167,03 | sand boils ground cracks |
| 326 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 45,280 | 24,670 | Corbeni | 157,57 | 217,55 | sand boils ground cracks |
| 327 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 44,890 | 26,700 | Corbu | 90,43 | 175,15 | sand boils ground cracks |
| 328 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 45,700 | 27,150 | Focsani | 42,73 | 155,97 | sand boils ground cracks |
| 329 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 45,020 | 25,170 | Malurile | 134,94 | 201,77 | sand boils ground cracks |
| 330 | Romania | 1838.01.23 | Vrancea | 45,700 | 26,600 | 7,5 | $M_w$ | 9 | 150 | 45,390 | 27,150 | Lamotesti | 54,99 | 159,76 | sand boils ground cracks |
| 331 | Greece | 1846.06.10 | Messinia | 37,15 | 22 | 6,78 | $M_w$ | 10 | | | | Pamisos r. Estuary | 13,50 | | A1 |
| 332 | Greece | 1846.06.10 | Messinia | 37,15 | 22 | 6,78 | $M_w$ | 10 | | | | Pamisos r. Estuary | 13,50 | | A2 |
| 333 | Greece | 1846.06.10 | Messinia | 37,15 | 22 | 6,78 | $M_w$ | 10 | | | | Mikromani | 8,00 | | A2 |
| 334 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,536 | 10,535 | Lorenzana | 7,66 | | Sand boils |
| 335 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,55 | 10,505 | Fauglia (Podere Acciaroli) | 10,02 | | Sand boils |
| 336 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,548 | 10,493 | Fauglia (Podere Fondo della Grotta) | 10,31 | | Water ejection |
| 337 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,547 | 10,515 | Fauglia (Podere delle Querce) | 9,37 | | Water ejection sand boils |
| 338 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,48 | 10,55 | Lorenzana- Podere SS. Marie | 1,47 | | Ground cracks sand boils |
| 339 | Italy | 1846.08.14 | Colline Pisane | 43,47 | 10,562 | 6,04 | $M_w$ | 9 | | 43,6 | 10,35 | Livorno- Podere Stagno | 22,39 | | Ground cracks sand boils |
| 340 | Italy | 1848.01.11 | Catania Gulf | 37,428 | 15,25 | 5,51 | $M_w$ | 7_8 | | 37,231 | 15,221 | Augusta | 22,06 | | A,B1 |
| 341 | Turkey | 1850.04.19 | Apolyon Lake | 40,098 | 28,778 | 6,7 | Mw | 8 | | | | Kermaste | 11,00 | | A1 |
| 342 | Greece | 1853.08.18 | Theba | 38,319 | 23,317 | 6,71 | $M_w$ | 9_10 | | 38,653 | 22,996 | Atalanti | 46,49 | | Liquefaction |
| 343 | Italy | 1854.02.12 | Cosenza Area | 39,256 | 16,259 | 6,34 | $M_w$ | 10 | | 39,344 | 16,165 | Cocchiano (C. da Miceli) | 12,70 | | A1, A4 |
| 344 | Italy | 1854.02.12 | Cosenza Area | 39,256 | 16,259 | 6,34 | $M_w$ | 10 | | 39,276 | 16,175 | Cerisano | 7,57 | | Cracks gas water ejection |
| 345 | Italy | 1854.02.12 | Cosenza Area | 39,256 | 16,259 | 6,34 | $M_w$ | 10 | | 39,367 | 16,167 | San Vincenzo la Costa- Valle del Drago | 14,67 | | water sand ejection |
| 346 | Italy | 1854.02.12 | Cosenza Area | 39,256 | 16,259 | 6,34 | $M_w$ | 10 | | 39,332 | 16,182 | Rende | 10,74 | | Ground cracks water sand ejection |
| 347 | Italy | 1854.02.12 | Cosenza Area | 39,256 | 16,259 | 6,34 | $M_w$ | 10 | | 39,339 | 16,145 | San Fili | 13,47 | | Ground cracks |
| 348 | Turkey | 1855.02.28 | Bursa | 40,183 | 29,067 | 7,02 | $M_w$ | 9_10 | | 40,034 | 28,400 | Kirmasti | 59,11 | | Unspecified |
| 349 | Italy | 1855.07.25 | Vallese, Stalden-Visp | 46,23 | 7,85 | 6,2 | $M_w$ | 8 | | 46,31 | 7,99 | Brig (CH) | 13,97 | | Landslide |
| 350 | Italy | 1857.12.16 | Basilicata | 40,352 | 15,842 | 7,12 | $M_w$ | 11 | | 40,45 | 15,516 | Atena (riverbanks) | 29,69 | | A1 |
| 351 | Italy | 1857.12.16 | Basilicata | 40,352 | 15,842 | 7,12 | $M_w$ | 11 | | 40,284 | 15,9 | Saponara (Agri river banks) | 9,02 | | B |
| 352 | Italy | 1857.12.16 | Basilicata | 40,352 | 15,842 | 7,12 | $M_w$ | 11 | | 40,376 | 15,824 | Marsico- Vetere | 3,07 | | Ground cracks |
| 353 | Italy | 1857.12.16 | Basilicata | 40,352 | 15,842 | 7,12 | $M_w$ | 11 | | 40,339 | 15,899 | Viggiano | 5,04 | | Water ejection |
| 354 | Greece | 1858.02.21 | Korinthos | 37,870 | 22,880 | 6,5 | $M_w$ | 9 | | 37,92 | 23,030 | Kalamaki | 14,29 | | Ground cracks |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 355 | Portugal | 1858.11.11 | Epicenter Offshore | 38,2 | -9 | 6,8 | $M_w$ | 8 | 38,52 | -8,89 | Setubal | 36,86 | Unspecified |
| 356 | Turkey | 1859.08.21 | Imvros Isle | 40,183 | 25,861 | 6,75 | $M_w$ | 9 | 40,112 | 25,778 | Kastro | 10,59 | Unspecified |
| 357 | Greece | 1861.12.26 | Aeghio | 38,222 | 22,139 | 6,85 | $M_w$ | 10 | 38,431 | 22,424 | Itea | 34,04 | ground cracks liquefaction |
| 358 | Greece | 1861.12.26 | Aeghio | 38,222 | 22,139 | 6,85 | $M_w$ | 10 | 38,428 | 22,443 | Kira | 35,05 | ground cracks liquefaction |
| 359 | Greece | 1861.12.26 | Aeghio | 38,222 | 22,139 | 6,85 | $M_w$ | 10 | 37,92 | 23,030 | Kalamaki | 84,94 | Ground cracks mud volcanoes |
| 360 | Greece | 1867.02.04 | Cephalonia Isle | 38,233 | 20,424 | 7,15 | $M_w$ | 10 | | | Lyxouri | 22,00 | A1 |
| 361 | Greece | 1867.02.04 | Cephalonia Isle | 38,233 | 20,424 | 7,15 | $M_w$ | 10 | | | Delaportata | 22,00 | A1 |
| 362 | Greece | 1867.02.04 | Cephalonia Isle | 38,233 | 20,424 | 7,15 | $M_w$ | 10 | | | Ag. Dimitrios | 23,00 | A2 |
| 363 | Greece | 1867.02.04 | Cephalonia Isle | 38,233 | 20,424 | 7,15 | $M_w$ | 10 | | | Koubalata | 23,00 | A2 |
| 364 | Greece | 1867.02.04 | Cephalonia Isle | 38,233 | 20,424 | 7,15 | $M_w$ | 10 | | | Argostoli | 22,00 | B3 |
| 365 | Greece | 1867.03.07 | Lesvos Isle | 39,25 | 26,2 | 6,85 | $M_w$ | 10 | | | Kalloni | 5,00 | A1 |
| 366 | Greece | 1867.03.07 | Lesvos Isle | 39,25 | 26,2 | 6,85 | $M_w$ | 10 | | | Perama | 34,00 | B3 |
| 367 | Greece | 1867.03.07 | Lesvos Isle | 39,25 | 26,2 | 6,85 | $M_w$ | 10 | | | Mitilini | 33,00 | B3 |
| 368 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Katavothra | 13,00 | A1 |
| 369 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Skliri | 10,00 | A2 |
| 370 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Larnaki | 12,00 | A2 |
| 371 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Kira | 10,00 | A2 |
| 372 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Itea | 5,00 | B3 |
| 373 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Desfina | 7,81 | C |
| 374 | Greece | 1870.08.01 | Arahova | 38,48 | 22,55 | 6,8 | $M_w$ | 9 | | | Thermopylae | 35,50 | C |
| 375 | Greece | 1870.08.01 | Arahova | 38,480 | 22,550 | 6,8 | $M_w$ | 9 | 38,432 | 22,423 | Itea | 12,28 | Liquefaction |
| 376 | Greece | 1870.08.01 | Arahova | 38,480 | 22,550 | 6,8 | $M_w$ | 9 | 38,379 | 22,381 | Galazidi | 18,52 | Liquefaction |
| 377 | Greece | 1870.08.01 | Arahova | 38,480 | 22,550 | 6,8 | $M_w$ | 9 | 38,527 | 22,378 | Amfisa | 15,86 | Liquefaction |
| 378 | Italy | 1870.10.04 | Cosenza Area | 39,22 | 16,331 | 6,24 | $M_w$ | 9_10 | 39,206 | 16,611 | San Giovanni in Fiore- Tore del Ponte | 24,18 | water sand ejection |
| 379 | Italy | 1870.10.04 | Cosenza Area | 39,22 | 16,331 | 6,24 | $M_w$ | 9_10 | 39,367 | 16,167 | San Vincenzo la Costa-Valle del Drago | 21,60 | water sand ejection |
| 380 | Italy | 1870.10.04 | Cosenza Area | 39,22 | 16,331 | 6,24 | $M_w$ | 9_10 | 39,661 | 16,023 | San Sosti | 55,73 | Sand boils |
| 381 | Greece | 1870.10.25 | Arahova | 38,48 | 22,45 | | | 8 | | | Larnaki | 4,00 | A2 |
| 382 | Greece | 1870.10.25 | Arahova | 38,48 | 22,45 | | | 8 | | | Itea | 5,00 | A2 |
| 383 | Italy | 1873.06.29 | Alpago Cansiglio | 46,159 | 12,383 | 6,29 | $M_w$ | 9_10 | 46,141 | 12,333 | Paludi del Lago S. Croce | 4,34 | A2 |
| 384 | Italy | 1873.06.29 | Alpago Cansiglio | 46,159 | 12,383 | 6,29 | $M_w$ | 9_10 | 46,142 | 12,333 | Farra d'Alpago | 4,29 | Water ejection |
| 385 | Italy | 1875.03.17 | Costa Romagnola | 44,209 | 12,659 | 5,74 | $M_w$ | 8 | 44,262 | 12,35 | Cervia | 25,32 | Ground changes |
| 386 | Italy | 1875.03.17 | Costa Romagnola | 44,209 | 12,659 | 5,74 | $M_w$ | 8 | 44,197 | 12,405 | Cesenatico | 20,30 | Ground cracks |
| 387 | Italy | 1875.12.06 | Gargano | 41,689 | 15,677 | 5,86 | $M_w$ | 8 | 41,604 | 15,9 | Manfredonia | 20,81 | Water ejection |
| 388 | Turkey | 1878.04.19 | Izmit | 40,375 | 30,106 | 6,25 | $M_w$ | 7_8 | 40,76 | 29,908 | Izmit | 45,97 | Unspecified |
| 389 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,769 | 16,128 | Drenje | 15,77 | sand boils |
| 390 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,770 | 16,165 | Trstenik | 16,17 | sand boils |
| 391 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,795 | 16,122 | Ivanja_reka | 12,79 | sand boils |
| 392 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,796 | 16,103 | Resnik | 12,67 | sand boils |
| 393 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,783 | 15,928 | Jarun | 19,95 | sand boils |
| 394 | Croatia | 1880.11.09 | Zagreb | 45,910 | 16,110 | 5,99 | $M_w$ | 9 | 45,777 | 15,839 | Stupnik | 25,72 | sand boils |
| 395 | Greece | 1881.04.03 | Hios Isle | 38,2 | 26,2 | 6,47 | $M_w$ | 10 | | | Hios | 26,00 | A1, A3 |
| 396 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 37,43 | -5,4 | Cortijo De Los Alamos | 137,11 | Unspecified |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 397 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 37,06 | -3,97 | Santa Cruz del Comercio | 11,46 | Unspecified |
| 398 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 37,58 | -5,93 | Llano de Las Donas (Mudapelo) | 186,73 | Unspecified |
| 399 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 36,92 | -3,63 | Pago de Las Ventas (Albunuelas) | 30,59 | Unspecified |
| 400 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 36,87 | -4,08 | Rio Bermuza (Canillas de Aceituno) | 13,70 | Unspecified |
| 401 | Spain | 1884.12.25 | Arenas Del Rey | 36,957 | -3,971 | 6,3 | $M_w$ | 9_10 | 36,77 | -4,09 | S.O. de Velez Malaga | 23,34 | Unspecified |
| 402 | Greece | 1886.08.27 | Filiatra | 36,988 | 24,467 | 7,16 | $M_w$ | 10 | | | Marathoupoli | 9,00 | A1 |
| 403 | France | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 43,77 | 7,494 | Nice | 42,16 | Soil liquefaction |
| 404 | France | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 43,774 | 7,498 | Menton | 41,72 | Soil liquefaction |
| 405 | Italy | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 44,049 | 8,213 | Albenga | 24,94 | water sand ejection |
| 406 | Italy | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 44,149 | 8,283 | Pietra Ligure | 36,95 | Sand boils |
| 407 | Italy | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 44,092 | 8,229 | Ceriale | 29,32 | Ground cracks sand boils |
| 408 | Italy | 1887.02.23 | Western Liguria | 43,891 | 7,992 | 6,27 | $M_w$ | 9 | 44,272 | 8,436 | Vado Centro- Vado Ligure | 55,27 | Ground cracks sand boils |
| 409 | Greece | 1888.09.09 | Aeghio | 38,238 | 22,079 | 6,29 | $M_w$ | 8_9 | 38,234 | 22,137 | Valimitika | 5,09 | Cracks liquefaction |
| 410 | Greece | 1888.09.09 | Aeghio | 38,238 | 22,079 | 6,29 | $M_w$ | 8_9 | 38,282 | 22,027 | Selianitika | 6,68 | Cracks liquefaction |
| 411 | Italy | 1889.10.13 | Carnia | 46,398 | 13,019 | 4,4 | $M_w$ | 6 | 46,408 | 13,005 | But river | 1,55 | A1 |
| 412 | Serbia | 1893.04.08 | Central Serbia | 44,300 | 21,300 | 6,42 | $M_w$ | 9 | 44,182 | 21,149 | Crkvenac | 17,83 | Sand_boil |
| 413 | Italy | 1893.04.22 | Monti Nebrodi | 38,001 | 15,028 | 4,83 | $M_w$ | 6_7 | 38,02 | 15,01 | Montalbano | 2,64 | B1 |
| 414 | Greece | 1893.05.23 | Theba | 38,310 | 23,250 | 6,2 | $M_w$ | 8 | 38,433 | 23,127 | Mulki | 17,38 | ground cracks |
| 415 | Italy | 1893.08.10 | Gargano | 41,713 | 16,075 | 5,39 | $M_w$ | 8 | 41,7 | 16,05 | Monte  Saraceno | 2,53 | A1 |
| 416 | Italy | 1894.03.25 | Gargano | 41,866 | 15,323 | 4,9 | $M_w$ | 6_7 | 41,9 | 15,35 | Punta  delle Pietre Nere | 4,39 | A1 |
| 417 | Greece | 1894.04.20 | Martino | 38,600 | 23,209 | 6,77 | $M_w$ | 10 | | | Skala Atalantis | 10,00 | B3 |
| 418 | Greece | 1894.04.20 | Martino | 38,600 | 23,209 | 6,77 | $M_w$ | 10 | 38,639 | 23,104 | Kiparisi | 10,10 | liquefaction |
| 419 | Greece | 1894.04.20 | Martino | 38,600 | 23,209 | 6,77 | $M_w$ | 10 | 38,714 | 23,060 | Livantes | 18,12 | liquefaction |
| 420 | Greece | 1894.04.27 | Ag. Konstantinos | 38,716 | 22,959 | 6,91 | $M_w$ | 10 | 38,721 | 23,060 | Livantes | 8,78 | subsidence |
| 421 | Greece | 1894.04.27 | Ag. Konstantinos | 38,716 | 22,959 | 6,91 | $M_w$ | 10 | 38,631 | 23,125 | Almyra | 17,24 | subsidence |
| 422 | Greece | 1894.04.27 | Ag. Konstantinos | 38,716 | 22,959 | 6,91 | $M_w$ | 10 | 38,499 | 22,973 | Orhomenos | 24,17 | Unspecified |
| 423 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,91 | 29,054 | Proti | 45,38 | ground cracks |
| 424 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,871 | 29,258 | Pendik | 28,02 | ground cracks |
| 425 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,629 | 29,007 | Karakoy | 47,73 | ground cracks |
| 426 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,614 | 28,964 | Katirli | 51,69 | ground cracks |
| 427 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,882 | 29,064 | Antigoni | 43,46 | ground cracks & lateral spreading |
| 428 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,423 | 29,161 | gemlik | 49,02 | ground cracks & lateral spreading |
| 429 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 40,684 | 29,494 | Hersek | 8,73 | liquefaction |
| 430 | Turkey | 1894.07.10 | Izmit | 40,750 | 29,550 | 6,7 | $M_w$ | 10 | 41,067 | 29,042 | Arnautkoy | 55,38 | subsidence |
| 431 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,146 | 15,215 | Barcellona Pozzo di Gotto | 59,38 | B1 |
| 432 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,252 | 15,608 | Ganzirri | 23,23 | B1 |
| 433 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,248 | 15,601 | Ganzirri | 23,91 | C1, C2 |
| 434 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,083 | 15,65 | Reggio Calabria (Acciarello) | 29,83 | B |
| 435 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,248 | 15,603 | Ganzirri | 23,74 | B2 |
| 436 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,266 | 15,646 | Torre Faro | 19,71 | B2 |
| 437 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | 38,187 | 15,529 | Messina Forms | 31,84 | B2, B3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 438 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | | 38,274 | 15,928 | Cosoleto | 5,30 | | Ground cracks sand boils |
| 439 | Italy | 1894.11.16 | Southern Calabria | 38,288 | 15,87 | 6,12 | $M_w$ | 9 | | 38,258 | 15,615 | Messina- Ganzirri | 22,52 | | Ground cracks sand boils |
| 440 | Italy | 1898.03.04 | Parma Area | 44,655 | 10,26 | 5,37 | $M_w$ | 7_8 | | 44,633 | 10,234 | Lesignano De' Bagni-Rivalta | 3,20 | | Unspecified |
| 441 | Greece | 1898.06.02 | Argos | 37,6 | 22,5 | 7 | $M_w$ | 7 | 80 | | | Inahos | 24,00 | 83,52 | C |
| 442 | Italy | 1898.11.02 | Calatino | 37,259 | 14,546 | 4,51 | $M_w$ | 5_6 | | 37,21 | 14,4 | Contrada Racineri | 14,03 | | A |
| 443 | Greece | 1899.01.22 | Kupparissia | 37,200 | 21,600 | 6,5 | $M_w$ | 9 | 10 | 37,235 | 21,636 | River bank | 5,03 | 11,19 | liquefaction subsidence |
| 444 | Greece | 1899.01.22 | Kupparissia | 37,200 | 21,600 | 6,5 | $M_w$ | 9 | 10 | 37,212 | 21,598 | Spilia | 1,35 | 10,09 | liquefaction subsidence |
| 445 | Turkey | 1899.09.20 | Aydin | 37,82 | 28,25 | 6,67 | $M_w$ | 9 | | | | Kocarli | 45,30 | | C |
| 446 | Turkey | 1899.09.20 | Aydin | 37,82 | 28,25 | 6,67 | $M_w$ | 9 | | | | Sahinli | 75,30 | | C |
| 447 | Turkey | 1899.09.20 | Aydin | 37,82 | 28,25 | 6,67 | $M_w$ | 9 | | | | Cellat | 81,00 | | C |
| 448 | Italy | 1901.03.29 | Val di Susa | 45,178 | 7,101 | 4,28 | $M_w$ | 5 | | 42,83 | 11,78 | San Casciano dei Bagni-Ponte a Rigo | 456,31 | | Unspecified |
| 449 | Italy | 1901.04.24 | Montelibretti | 42,1 | 12,736 | 5,25 | $M_w$ | 8 | | 42,066 | 12,767 | Palombara Sabina | 4,57 | | Gas emission |
| 450 | Italy | 1901.10.30 | Garda Occidentale | 45,548 | 10,49 | 5,44 | $M_w$ | 7_8 | | 45,6 | 10,516 | Salo` | 6,13 | | A1, B |
| 451 | Italy | 1902.03.05 | Garfagnana | 44,093 | 10,463 | 4,98 | $M_w$ | 7 | | 44,132 | 10,41 | Pieve Fosciana | 6,06 | | Ground cracks |
| 452 | Greece | 1902.07.05 | Assiros | 40,82 | 23,04 | 6,4 | $M_w$ | 9 | 11 | | | Assiros | 3,00 | 11,40 | A1 |
| 453 | Greece | 1902.07.05 | Assiros | 40,82 | 23,04 | 6,4 | $M_w$ | 9 | 11 | | | Lagadas | 10,00 | 14,87 | A2 |
| 454 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,881 | 23,111 | Kresna | 35,23 | 38,29 | lateral spreading |
| 455 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,890 | 22,813 | Kresna | 13,71 | 20,32 | lateral spreading and failure of river bank |
| 456 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 42,062 | 23,034 | Kresna | 40,16 | 42,87 | Sand boil |
| 457 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 42,145 | 23,019 | Kresna | 46,57 | 48,93 | Sand boil e water ejection |
| 458 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,887 | 22,457 | Kresna | 22,34 | 26,91 | Sand boil e water ejection |
| 459 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,869 | 22,435 | Kresna | 23,26 | 27,68 | Sand boil e water ejection |
| 460 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,986 | 23,076 | Kresna | 37,34 | 40,24 | ground cracks and water ejection |
| 461 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,404 | 22,883 | Kresna | 46,59 | 48,94 | Unspecified |
| 462 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,386 | 22,824 | Kresna | 47,15 | 49,47 | Unspecified |
| 463 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,439 | 22,797 | Kresna | 41,01 | 43,67 | Unspecified |
| 464 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,490 | 22,700 | Kresna | 34,48 | 37,60 | Unspecified |
| 465 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,189 | 22,500 | Kresna | 69,97 | 71,56 | Unspecified |
| 466 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,409 | 22,226 | Kresna | 58,70 | 60,58 | Unspecified |
| 467 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,488 | 22,120 | Kresna | 59,40 | 61,26 | Unspecified |
| 468 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 41,599 | 21,970 | Kresna | 64,61 | 66,33 | Unspecified |
| 469 | Bulgaria | 1904.04.04 | Kresna | 41,800 | 22,700 | 6,9 | $M_w$ | 10 | 15 | 42,146 | 21,709 | Kresna | 90,52 | 91,75 | Unspecified |
| 470 | Albania | 1905.06.01 | Shkodra | 42,000 | 19,500 | 6,6 | $M_w$ | 9 | 11 | 41,998 | 19,562 | Kosmac | 5,13 | 12,14 | river bank failure |
| 471 | Albania | 1905.06.01 | Shkodra | 42,000 | 19,500 | 6,6 | $M_w$ | 9 | 11 | 42,038 | 19,495 | Bahacallek | 4,25 | 11,79 | Unspecified |
| 472 | Albania | 1905.06.01 | Shkodra | 42,000 | 19,500 | 6,6 | $M_w$ | 9 | 11 | 42,062 | 19,500 | Shkodra | 6,90 | 12,98 | Unspecified |
| 473 | Albania | 1905.06.01 | Shkodra | 42,000 | 19,500 | 6,6 | $M_w$ | 9 | 11 | | | Buna River | 6,70 | 12,88 | Unspecified |
| 474 | Albania | 1905.06.01 | Shkodra | 42,000 | 19,500 | 6,6 | $M_w$ | 9 | 11 | | | Bardullush | 14,40 | 18,12 | Unspecified |
| 475 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,709 | 16,103 | Bivona [2] | 62,25 | | A1, A4 |
| 476 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,131 | 16,081 | Amantea | 83,46 | | Sand boils |
| 477 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,792 | 16,447 | Amaroni | 93,36 | | Ground cracks sand boils |
| 478 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,518 | 15,938 | Cetraro | 112,18 | | Liquefaction |
| 479 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,826 | 16,311 | Acconia- Curinga | 82,96 | | Ground cracks sand boils |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 480 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,962 | 16,388 | Feroleto Antico | 94,66 | | Ground cracks water sand ejection |
| 481 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,707 | 16,191 | Maierato | 69,73 | | Ground cracks sand boils |
| 482 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,927 | 16,494 | Marcellinara | 101,61 | | Ground cracks lateral spreading |
| 483 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,554 | 15,938 | Nicotera | 47,06 | | Water ejection |
| 484 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,405 | 16,159 | Montalto Uffugo | 111,00 | | Sand boils |
| 485 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,367 | 16,167 | San Vincenzo la Costa- Valle del Drago | 108,05 | | Sand boils |
| 486 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,489 | 15,973 | Rosarno | 51,35 | | Ground cracks sand boils |
| 487 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,967 | 16,273 | Sambiase | 86,00 | | Water ejection |
| 488 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,167 | 16,149 | Lago | 90,46 | | Water ejection |
| 489 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,324 | 15,888 | Seminara- Sant'Anna di Seminara | 52,43 | | Landslide |
| 490 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,044 | 16,149 | Nocera Terinese- S. Sisti (S. Sisto dei Valdesi) | 81,56 | | Ground cracks |
| 491 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 39,082 | 16,244 | Martinaro | 90,67 | | Ground cracks water ejection |
| 492 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,511 | 15,961 | Candinoni-Sovareto | 49,79 | | Water ejection |
| 493 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,678 | 15,898 | Tropea | 44,13 | | Ground cracks sand boils |
| 494 | Italy | 1905.09.08 | Central Calabria | 38,6 | 15,4 | 6,95 | $M_w$ | 10_11 | | 38,651 | 16,298 | Vallelonga | 78,24 | | Sand boils |
| 495 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,266 | 15,646 | Torre Faro | 13,82 | | B1, B2, B3, C2 |
| 496 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,248 | 15,601 | Ganzirri | 13,61 | | C1 |
| 497 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,253 | 15,609 | Ganzirri | 13,72 | | C2, B2 |
| 498 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,248 | 15,613 | Ganzirri | 13,06 | | A |
| 499 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,187 | 15,549 | Messina | 12,90 | | B1, B2, A |
| 500 | Italy | 1908.12.28 | Messina Strait | 38,146 | 15,687 | 7,1 | $M_w$ | 11 | | 38,119 | 15,653 | Reggio Calabria | 4,23 | | Ground cracks sand boils subsidence |
| 501 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,02 | -8,79 | Salvaterra | 2,39 | | Unspecified |
| 502 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,76 | -9,23 | S. Bras | 45,81 | | Unspecified |
| 503 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,71 | -9,12 | Santo Estevao | 42,53 | | Unspecified |
| 504 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,92 | -8,88 | Samora | 11,27 | | Unspecified |
| 505 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,99 | -8,96 | Castanheira | 13,88 | | Unspecified |
| 506 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,02 | -8,96 | Carregado | 14,01 | | Unspecified |
| 507 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,951 | -8,98 | Benavente | 16,49 | | Unspecified |
| 508 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,95 | -8,98 | Cabo Ruivo (junto a Vila Franca de Xira) | 16,53 | | Unspecified |
| 509 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,93 | -9,25 | Moio de Port'Alvo (junto da Malveira) | 39,69 | | Unspecified |
| 510 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,06 | -8,86 | Azambuja | 8,45 | | Unspecified |
| 511 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,07 | -8,78 | Reguengo | 7,98 | | Unspecified |
| 512 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,23 | -8,68 | Santarem | 27,60 | | Unspecified |
| 513 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,91 | -8,88 | Porto Alto | 12,17 | | Unspecified |
| 514 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,78 | -9,15 | Torrinha | 38,95 | | Unspecified |
| 515 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,91 | -8,6 | Biscainho | 19,99 | | Unspecified |
| 516 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 39,08 | -8,76 | Valada | 9,55 | | Unspecified |
| 517 | Portugal | 1909.04.23 | Benavente | 39 | -8,8 | 6 | $M_w$ | 10 | | 38,919 | -9 | Alhandra | 19,50 | | Unspecified |
| 518 | Greece | 1909.05.30 | Fokida | 38,250 | 22,200 | 6 | $M_w$ | 8 | 20 | 38,299 | 22,021 | Kamara | 16,55 | 25,96 | liquefaction |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 519 | Greece | 1909.05.30 | Fokida | 38,250 | 22,200 | 6 | $M_w$ | 8 | 20 | 38,366 | 22,126 | Spiridon | 14,43 | 24,66 | liquefaction |
| 520 | Italy | 1909.08.25 | Crete Senesi | 43,15 | 11,403 | 5,35 | $M_w$ | 7_8 | | 43,15 | 11,283 | Macereto | 9,74 | | C |
| 521 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,417 | 16,157 | Glinska_Poljana | 9,59 | 15,84 | ground cracks water ejection |
| 522 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,399 | 16,094 | Mala_solina | 8,33 | 15,11 | ground cracks water ejection |
| 523 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,386 | 16,146 | Marinbrod | 11,50 | 17,06 | ground cracks water ejection |
| 524 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,484 | 16,205 | Nebojan | 11,42 | 17,00 | ground cracks water ejection |
| 525 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,462 | 16,117 | Vratecko | 4,53 | 13,39 | ground cracks water ejection |
| 526 | Croatia | 1909.10.08 | Kupa Valley | 45,470 | 16,060 | 5,8 | $M_w$ | 8 | 12,6 | 45,452 | 16,263 | Brest_Pokupski | 15,96 | 20,34 | a well up to half filled with sand |
| 527 | Hungary | 1911.07.08 | Kecskemet | 46,900 | 19,680 | 5,6 | $M_w$ | 8 | 12 | 46,928 | 19,641 | Baranyi_farm | 4,30 | 12,75 | sand boil |
| 528 | Greece | 1912.01.24 | Cephalonia Isle | 38,1 | 20,5 | 6,1 | $M_w$ | 10 | 11 | | | Zakynthos | 49,00 | 50,22 | B2, B3 |
| 529 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,108 | 28,665 | Apolyon Lake | 140,47 | 140,82 | Unspecified |
| 530 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,132 | 28,492 | Apolyon Lake | 126,34 | 126,73 | Unspecified |
| 531 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,405 | 26,644 | Gallipoli | 57,31 | 58,18 | Unspecified |
| 532 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,592 | 26,843 | Kavakkoy | 32,43 | 33,94 | Unspecified |
| 533 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,634 | 26,825 | Kocacesme | 32,48 | 33,98 | Unspecified |
| 534 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,629 | 26,499 | Mecidiye | 59,67 | 60,50 | Unspecified |
| 535 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,736 | 26,051 | Enez | 96,94 | 97,46 | Unspecified |
| 536 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 41,341 | 28,548 | Terkos lake | 133,71 | 134,08 | Unspecified |
| 537 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 41,266 | 28,687 | Uzunkopru | 139,83 | 140,18 | Unspecified |
| 538 | Turkey | 1912.08.12 | Murefte | 40,7 | 27,2 | 7,4 | $M_w$ | 10 | 10 | 40,666 | 27,245 | Murefte | 5,36 | 11,34 | Unspecified |
| 539 | Greece | 1914.11.27 | Lefkas Isle | 38,65 | 20,62 | 5,9 | $M_w$ | 9 | 6 | | | Kalamitisi | 11,00 | 12,53 | A3 |
| 540 | Greece | 1914.11.27 | Lefkas Isle | 38,65 | 20,62 | 5,9 | $M_w$ | 9 | 6 | | | Ag. Nikitas | 14,00 | 15,23 | A2 |
| 541 | Greece | 1914.11.27 | Lefkas Isle | 38,65 | 20,62 | 5,9 | $M_w$ | 9 | 6 | | | Nydri | 11,00 | 12,53 | B3 |
| 542 | Greece | 1914.11.27 | Lefkas Isle | 38,65 | 20,62 | 5,9 | $M_w$ | 9 | 6 | | | Lefkada | 10,00 | 11,66 | B3, B3 |
| 543 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,033 | 13,516 | Fucino Strada 12 [ 2 ] | 2,41 | 5,55 | C |
| 544 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,322 | 12,986 | Concerviano | 56,43 | 56,65 | Ground cracks sand boils |
| 545 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,05 | 13,483 | Avezzano- Fucino strada 11 | 5,58 | 7,49 | Ground cracks |
| 546 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 41,983 | 13,633 | Pescina-Fucino strada 24 | 9,19 | 10,46 | water sand ejection |
| 547 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,025 | 13,657 | Pescina | 10,57 | 11,69 | water sand ejection |
| 548 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,016 | 13,65 | Pescina | 9,92 | 11,11 | Ground cracks |
| 549 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,006 | 13,624 | San Benedetto dei Marsi | 7,82 | 9,28 | Water ejection lateral spreading |
| 550 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 41,99 | 13,637 | Pescocostanzo-Molino di Venere | 9,24 | 10,50 | water sand ejection |
| 551 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 41,994 | 13,551 | Roccaraso- Bacinetto canale | 2,82 | 5,74 | water sand ejection |
| 552 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 42,01 | 13,513 | Celano-Fosso 13 | 1,47 | 5,21 | water sand ejection |
| 553 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 41,97 | 13,61 | Ortucchio-Piana da Trasacco | 8,23 | 9,63 | water sand ejection |
| 554 | Italy | 1915.01.13 | Marsica | 42,014 | 13,53 | 6,99 | $M_w$ | 11 | 5 | 41,718 | 13,615 | Sora | 33,67 | 34,04 | sand boils |
| 555 | Greece | 1915.08.07 | Ithaki Isle | 38,5 | 20,5 | 6,3 | $M_w$ | 9 | 12 | | | Sami | 18,00 | 21,63 | A3 |
| 556 | Italy | 1916.05.17 | Rimini Area | 44,119 | 12,748 | 5,82 | $M_w$ | 8 | | 44,05 | 12,566 | Rimini | 16,44 | | A1 |
| 557 | Italy | 1916.08.16 | Rimini Area | 44,019 | 12,737 | 6,14 | $M_w$ | 8 | | 43,964 | 12,742 | Cattolica | 6,13 | | Ground cracks |
| 558 | Italy | 1916.08.16 | Rimini Area | 44,019 | 12,737 | 6,14 | $M_w$ | 8 | | 43,983 | 12,667 | Riccione- Ghetto delle Fontanelle | 6,88 | | water sand ejection |
| 559 | Italy | 1916.08.16 | Rimini Area | 44,019 | 12,737 | 6,14 | $M_w$ | 8 | | 43,904 | 12,905 | Pesaro | 18,56 | | Ground cracks |
| 560 | Italy | 1916.08.16 | Rimini Area | 44,019 | 12,737 | 6,14 | $M_w$ | 8 | | 44,001 | 12,659 | Riccione | 6,55 | | Ground cracks water sand ejection |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 561 | Italy | 1916.08.16 | Rimini Area | 44,019 | 12,737 | 6,14 | $M_w$ | 8 | | 44,059 | 12,569 | Rimini | 14,15 | | Liquefaction ground changes |
| 562 | Italy | 1917.04.26 | Alta Val Tiberina | 43,467 | 12,129 | 5,74 | $M_w$ | 9_10 | | 43,498 | 12,116 | Citerna | 3,60 | | Ground cracks water sand ejection |
| 563 | Italy | 1917.04.26 | Alta Val Tiberina | 43,467 | 12,129 | 5,74 | $M_w$ | 9_10 | | 43,483 | 12,097 | Monterchi- fiumi Cerfone e Sovara | 3,14 | | Ground cracks water sand ejection |
| 564 | Italy | 1919.06.29 | Mugello | 43,957 | 11,482 | 6,26 | $M_w$ | 10 | | 43,94 | 11,44 | Vecchio-Piano di Cistio- F. Sieve | 3,86 | | Water ejections |
| 565 | Italy | 1919.06.29 | Mugello | 43,957 | 11,482 | 6,26 | $M_w$ | 10 | | 43,94 | 11,41 | Borgo San Lorenzo- Piano di Ribatta- F. Sieve | 6,07 | | Ground cracks |
| 566 | Spain | 1919.09.10 | Jacarilla/ Torremendo | 38,08 | -0,83 | 5,3 | $M_w$ | 8 | | 38,06 | -0,86 | Jacarilla | 3,44 | | Unspecified |
| 567 | Italy | 1919.09.10 | Val di Paglia | 42,793 | 11,788 | 5,42 | $M_w$ | 7_8 | | 42,833 | 11,783 | San Casciano dei Bagni-Ponte a Rigo | 4,47 | | Water ejection |
| 568 | Greece | 1921.09.13 | Amfilohia | 38,82 | 20,93 | 5,5 | $M_w$ | 8 | 11 | | | Amfiloxia | 4,50 | 11,88 | B3 |
| 569 | Greece | 1926.03.18 | Kastelorizo Isle | 35,840 | 29,500 | 6,5 | $M_w$ | 8 | 10 | 36,148 | 29,590 | Kastellorizo | 35,20 | 36,59 | Unspecified |
| 570 | Albania | 1926.12.17 | Dyrrachium | 41,3 | 19,5 | 6,3 | $M_w$ | 9 | 20 | | | Durres | 5,60 | 20,77 | A2 |
| 571 | Albania | 1926.12.17 | Dyrrachium | 41,3 | 19,5 | 6,3 | $M_w$ | 9 | 20 | | | Shijak | 61,00 | 64,20 | A2 |
| 572 | Turkey | 1928.03.31 | Torbali | 38,18 | 27,8 | 6,3 | $M_w$ | 9 | 10 | | | Cile | 31,50 | 33,05 | C |
| 573 | Turkey | 1928.03.31 | Torbali | 38,18 | 27,8 | 6,3 | $M_w$ | 9 | 10 | | | Ahmelti | 18,00 | 20,59 | C |
| 574 | Turkey | 1928.03.31 | Torbali | 38,18 | 27,8 | 6,3 | $M_w$ | 9 | 10 | | | Ucpinar | 20,10 | 22,45 | C |
| 575 | Greece | 1928.04.22 | Corinthos | 37,94 | 22,98 | 6,3 | $M_w$ | 9 | 8 | | | Kalamaki | 5,00 | 9,43 | A1 |
| 576 | Greece | 1928.04.22 | Corinthos | 37,94 | 22,98 | 6,3 | $M_w$ | 9 | 8 | | | Brahati | 15,50 | 17,44 | A1 |
| 577 | Greece | 1928.04.22 | Corinthos | 37,94 | 22,98 | 6,3 | $M_w$ | 9 | 8 | | | Neranza | 18,00 | 19,70 | A1 |
| 578 | Greece | 1928.04.22 | Corinthos | 37,94 | 22,98 | 6,3 | $M_w$ | 9 | 8 | | | Corinthos | 3,00 | 8,54 | A5 |
| 579 | Greece | 1928.04.22 | Corinthos | 37,94 | 22,98 | 6,3 | $M_w$ | 9 | 8 | | | Loutraki | 4,00 | 8,94 | B2 |
| 580 | Greece | 1930.04.17 | Corinthos | 37,800 | 23,170 | 5,9 | $M_w$ | 8 | 66 | 37,843 | 23,010 | Almyri | 14,85 | 67,65 | ground craks |
| 581 | Italy | 1930.07.23 | Irpinia | 41,07 | 15,36 | 6,62 | $M_w$ | 10 | 14,6 | 41,033 | 15,283 | Carosina | 7,66 | 16,49 | A1 |
| 582 | Italy | 1930.07.23 | Irpinia | 41,07 | 15,36 | 6,62 | $M_w$ | 10 | 14,6 | 41,2 | 15,033 | Montecalvo Irpino [ 2 ] | 30,98 | 34,24 | A1 |
| 583 | Italy | 1930.10.30 | Senigallia | 43,689 | 13,385 | 6,02 | $M_w$ | 8 | 14,6 | 44,56 | 10,57 | Viano - Regnano | 244,73 | 245,16 | water sand ejection |
| 584 | FYROM | 1931.03.08 | Valadovo | 41,28 | 22,49 | 6,7 | $M_w$ | 10 | 10 | | | Valadovo | 40,00 | 41,23 | C |
| 585 | Greece | 1932.09.26 | Chalkidiki | 40,45 | 23,76 | 6,8 | $M_w$ | 10 | 5 | | | Unspecified | 52,00 | 52,24 | A5 |
| 586 | Turkey | 1935.01.04 | Erdek | 40,4 | 27,5 | 6,2 | $M_w$ | 9 | | | | Islet if Haysriz | 34,00 | | A3 |
| 587 | Greece | 1938.07.20 | Oropos | 38,300 | 23,660 | 5,9 | $M_w$ | 8 | 42 | 38,319 | 23,793 | Palatia | 11,80 | 43,63 | Ground cracks and sand boils |
| 588 | Greece | 1938.07.20 | Oropos | 38,300 | 23,660 | 5,9 | $M_w$ | 8 | 42 | 38,333 | 23,762 | Oropu | 9,63 | 43,09 | Ground cracks and sand boils |
| 589 | Greece | 1938.07.20 | Oropos | 38,300 | 23,660 | 5,9 | $M_w$ | 8 | 42 | 38,333 | 23,730 | Chalkoutsi | 7,13 | 42,60 | Ground cracks and sand boils |
| 590 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,707 | 22,427 | Kouluri | 3,81 | 25,29 | river bank failure |
| 591 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,727 | 22,425 | Kouluri2 | 3,01 | 25,18 | river bank failure |
| 592 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,753 | 22,413 | Girtoni | 4,76 | 25,45 | river bank failure |
| 593 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,682 | 22,443 | Omorfochori | 5,53 | 25,61 | river bank failure |
| 594 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,608 | 22,568 | Glafki | 16,42 | 29,91 | river bank failure |
| 595 | Greece | 1941.03.01 | Larisa | 39,730 | 22,460 | 6,1 | $M_w$ | 8 | 25 | 39,656 | 22,583 | Eleftherio | 13,36 | 28,35 | river bank failure |
| 596 | Greece | 1947.10.06 | Messinia | 36,710 | 21,790 | 6,5 | $M_w$ | 9 | 2 | 36,801 | 21,947 | Corone | 17,27 | 17,38 | Unspecified |
| 597 | Greece | 1947.10.06 | Messinia | 36,710 | 21,790 | 6,5 | $M_w$ | 9 | 2 | 36,962 | 21,691 | Gialova | 29,38 | 29,45 | Unspecified |
| 598 | Greece | 1948.04.22 | Lefkas Isle | 38,68 | 20,57 | 6,5 | $M_w$ | 9 | 12 | | | Basiliki | 3,00 | 12,37 | A5 |
| 599 | Greece | 1948.06.30 | Lefkas Isle | 38,8 | 20,6 | 6,5 | $M_w$ | 9 | 36 | | | Lefkada | 10,00 | 37,36 | B3 |
| 600 | Albania | 1948.08.27 | Shkodora | 42 | 19,5 | 5,3 | $M_w$ | 8 | 41 | | | Trush | 5,50 | 41,37 | A1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 601 | Greece | 1949.07.23 | Hios Isle | 38,58 | 26,23 | 6,7 | $M_w$ | 9 | 17 | | | Hios | 23,00 | 28,60 | B3 |
| 602 | Turkey | 1953.03.18 | Yenise | 40,02 | 27,53 | 7,2 | $M_w$ | 9 | | | | Lake Manyas | 60,00 | | C |
| 603 | Greece | 1953.08.12 | Cephalonia Isle | 38,1 | 20,35 | 7 | $M_w$ | 10 | 11 | | | Lyxouri | 13,00 | 17,03 | B3 |
| 604 | Greece | 1953.08.12 | Cephalonia Isle | 38,1 | 20,35 | 7 | $M_w$ | 10 | 11 | | | Ithaki (Bathi) | 43,00 | 44,38 | B3 |
| 605 | Greece | 1953.08.12 | Cephalonia Isle | 38,1 | 20,35 | 7 | $M_w$ | 10 | 11 | | | Agostoli | 15,00 | 18,60 | B3 |
| 606 | Greece | 1953.08.12 | Cephalonia Isle | 38,1 | 20,35 | 7 | $M_w$ | 10 | 11 | | | Zakynthos | 60,00 | 61,00 | B3, B3 |
| 607 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,345 | 22,337 | Mikro evidrio | 13,70 | 21,06 | Unspecified |
| 608 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,263 | 22,755 | Aghialos | 41,08 | 44,09 | Unspecified |
| 609 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,366 | 22,940 | Volos | 58,79 | 60,93 | Unspecified |
| 610 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,340 | 23,010 | Agria | 64,03 | 65,99 | Unspecified |
| 611 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,093 | 22,227 | Panagia | 15,91 | 22,56 | Unspecified |
| 612 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,080 | 22,424 | Karies | 20,80 | 26,24 | Unspecified |
| 613 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,341 | 22,198 | Pashalitsa | 14,22 | 21,41 | Unspecified |
| 614 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,366 | 22,215 | Polineri | 16,13 | 22,72 | Unspecified |
| 615 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,264 | 22,320 | Vrisisa | 5,12 | 16,80 | Unspecified |
| 616 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,392 | 22,137 | Kipseli | 21,82 | 27,06 | Unspecified |
| 617 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,194 | 22,249 | Petrilia | 4,81 | 16,71 | Unspecified |
| 618 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,401 | 21,890 | Artesiano | 38,58 | 41,76 | Unspecified |
| 619 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,066 | 22,206 | Perivoli | 19,33 | 25,09 | Unspecified |
| 620 | Greece | 1954.04.30 | Sofades | 39,230 | 22,280 | 6,5 | $M_w$ | 9 | 16 | 39,132 | 22,380 | Vuzi | 13,90 | 21,19 | Unspecified |
| 621 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,342 | 19,045 | Szilágyi_street | 3,49 | 14,43 | sand boils siltation of dug wells |
| 622 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,346 | 19,048 | Árpád_street | 3,17 | 14,35 | sand boils siltation of dug wells |
| 623 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,345 | 19,049 | Rákóczi_street | 3,12 | 14,34 | sand boils siltation of dug wells |
| 624 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,357 | 19,094 | Damjanich_street | 0,86 | 14,03 | sand boils siltation of dug wells |
| 625 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,360 | 19,087 | Duna_street | 1,15 | 14,05 | sand boils siltation of dug wells |
| 626 | Hungary | 1956.01.12 | Dunaharaszti | 47,350 | 19,090 | 5,5 | $M_w$ | 8 | 14 | 47,336 | 19,059 | Liget_Csarda (Taksony) | 2,83 | 14,28 | sand boils ground cracks |
| 627 | Albania | 1959.09.01 | Lushnje | 40,850 | 19,960 | 6,3 | $M_w$ | 8_9 | 25 | 40,817 | 19,869 | Kozare | 8,49 | 26,40 | Unspecified |
| 628 | Albania | 1962.03.18 | Fier | 40,7 | 19,63 | 5,9 | $M_w$ | 8 | 15 | | | Mifol | 14,00 | 20,52 | A1 |
| 629 | Albania | 1962.03.18 | Fier | 40,7 | 19,63 | 5,9 | $M_w$ | 8 | 15 | | | Novosel | 14,00 | 20,52 | A1 |
| 630 | Albania | 1962.03.18 | Fier | 40,7 | 19,63 | 5,9 | $M_w$ | 8 | 15 | | | Fier | 8,00 | 17,00 | A1 |
| 631 | Greece | 1965.07.06 | Eratini | 38,37 | 22,4 | 6,2 | $M_w$ | 8 | 18 | 38,239 | 22,131 | Temeni | 27,63 | 32,98 | Unspecified |
| 632 | Greece | 1965.07.06 | Eratini | 38,37 | 22,4 | 6,2 | $M_w$ | 8 | 18 | 38,169 | 22,326 | Acrata | 23,27 | 29,42 | Unspecified |
| 633 | Greece | 1965.07.06 | Eratini | 38,37 | 22,4 | 6,2 | $M_w$ | 8 | 18 | 38,355 | 22,220 | Eratini | 15,79 | 23,94 | Unspecified |
| 634 | Greece | 1966.10.29 | Amfilohia | 38,78 | 21,11 | 5,7 | $M_w$ | 8 | 1 | | | Amfilohia | 9,00 | 9,06 | B3 |
| 635 | Turkey | 1967.07.22 | Mudurnu | 40,7 | 30,7 | 7,3 | $M_w$ | 10 | | | | Cihadiye | 43,00 | | A1 |
| 636 | Turkey | 1967.07.22 | Mudurnu | 40,7 | 30,7 | 7,3 | $M_w$ | 10 | | | | Cihadiye | 43,00 | | A2 |
| 637 | Turkey | 1967.07.22 | Mudurnu | 40,7 | 30,7 | 7,3 | $M_w$ | 10 | | | | Sapanca | 40,00 | | A1, A2, A4 |
| 638 | Turkey | 1967.07.22 | Mudurnu | 40,7 | 30,7 | 7,3 | $M_w$ | 10 | | | | Adapazari | 20,00 | | A1, A2, B5 |
| 639 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,706 | 13,259 | Bisacquino | 21,76 | 21,96 | Liquefaction |
| 640 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,7 | 13,266 | Bisacquino | 22,58 | 22,78 | Ground cracks water sand ejection |
| 641 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,897 | 13,096 | Camporeale | 14,25 | 14,56 | Ground cracks water sand ejection |
| 642 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,741 | 13,001 | Salaparuta- C. da Mulino Nuovo | 5,03 | 5,86 | Ground cracks |
| 643 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,729 | 13,185 | Contessa Entellina | 14,76 | 15,07 | Ground cracks water sand ejection |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 644 | Italy | 1968.01.15 | Belice Valley | 37,78 | 13,03 | 5,67 | $M_w$ | 10 | 3 | 37,7 | 12,933 | Pantanna- Timpone Perollo | 12,33 | 12,69 | Ground cracks water sand ejection |
| 645 | Turkey | 1968.09.03 | Amasra | 41,777 | 32,45 | 5,81 | $M_w$ | | 5 | 41,645 | 32,378 | Camalti | 15,85 | 16,62 | Sand boils & open cracks |
| 646 | Turkey | 1969.03.28 | Alasehir | 38,29 | 28,5 | 6,2 | $M_w$ | 8 | 4 | | | Unspecified | 35,00 | 35,23 | C |
| 647 | Turkey | 1970.03.28 | Gediz | 39,21 | 29,51 | 6,2 | $M_w$ | 9 | 18 | 39,097 | 28,977 | Simav | 47,66 | 50,94 | Sand boils |
| 648 | Turkey | 1970.03.28 | Gediz | 39,21 | 29,51 | 6,2 | $M_w$ | 9 | 18 | 39,343 | 29,256 | Emet | 26,40 | 31,95 | Sand boils |
| 649 | Turkey | 1970.03.28 | Gediz | 39,21 | 29,51 | 6,2 | $M_w$ | 9 | 18 | 38,991 | 29,401 | Gediz | 26,11 | 31,72 | Sand boils |
| 650 | Turkey | 1971.05.12 | Burdur Lake | 37,64 | 29,72 | 5,8 | $M_w$ | 8 | 30 | 37,581 | 30,094 | Hacilar | 33,60 | 45,04 | Sand boils |
| 651 | Turkey | 1971.05.12 | Burdur Lake | 37,64 | 29,72 | 5,8 | $M_w$ | 8 | 30 | 37,621 | 30,065 | Yarkoy | 30,46 | 42,76 | Sand boils |
| 652 | Turkey | 1975.03.27 | Saros | 40,4 | 26,1 | 5,8 | $M_w$ | 7 | 15 | | | Kavak Suyu | 68,00 | 69,63 | C |
| 653 | Greece | 1975.12.31 | Aetolia | 38,49 | 21,7 | 5,4 | $M_w$ | 8 | 19 | | | Unspecified | 7,00 | 20,25 | C |
| 654 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,048 | 13,083 | Tomba est | 29,04 | 29,60 | A4, D |
| 655 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,227 | 13,077 | Tomba di sotto | 17,51 | 18,42 | D |
| 656 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,21 | 13,082 | Tomba di sotto-Presa | 17,67 | 18,56 | D |
| 657 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,29 | 13,05 | Trasaghis- Avasinis | 19,39 | 20,21 | Ground cracks water sand ejection |
| 658 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,306 | 13,101 | Bordano- Salez | 15,99 | 16,97 | Ground cracks water sand ejection |
| 659 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,303 | 13,115 | Bordano- Alveo del F. Tagliamento | 14,86 | 15,92 | Ground cracks water sand ejection |
| 660 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,248 | 13,098 | Osoppo- Colle Cucchiaro | 15,54 | 16,55 | sand boils |
| 661 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,206 | 13,043 | Majano- Colle Baracchino | 20,66 | 21,43 | Ground cracks sand boils |
| 662 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,2 | 13,066 | Majano- Casa Toful | 19,21 | 20,04 | ground cracks sand boils |
| 663 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,239 | 13,095 | Campo Buia (C. Ledra-Tagliamento) | 15,90 | 16,89 | sand boils |
| 664 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,236 | 13,104 | Campo Buia ( Rio Campo) | 15,27 | 16,30 | sand boils |
| 665 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,231 | 13,105 | Campo Buia (C.Garzolino) | 15,32 | 16,34 | sand boils |
| 666 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,229 | 13,096 | Campo Buia (Campo) | 16,04 | 17,02 | sand boils |
| 667 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,225 | 13,096 | Campo Buia (Sorgente Rio Gelato) | 16,15 | 17,13 | liquefaction |
| 668 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,27 | 13,143 | Gemona del Friuli- Godo | 12,03 | 13,31 | Ground cracks water sand ejection |
| 669 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,269 | 13,141 | Gemona del Friuli- La Roggia | 12,17 | 13,44 | sand boils |
| 670 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,218 | 13,016 | Osoppo-Laghetti Palar | 22,31 | 23,03 | liquefaction |
| 671 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,25 | 13,12 | Lessi | 13,83 | 14,96 | sand boils |
| 672 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,245 | 13,114 | Gemona del Friuli (Campo Lessi) | 14,35 | 15,44 | sand boils |
| 673 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,243 | 13,126 | Gemona del Friuli- F. Ledra | 13,47 | 14,63 | sand boils |
| 674 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,19 | 13,05 | Majano Susans | 20,77 | 21,53 | sand boils |
| 675 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,184 | 13,071 | Majano | 19,57 | 20,39 | Ground cracks sand boils |
| 676 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,182 | 13,11 | Colloredo di Monte Albano-Lauzzara- Maneva | 17,05 | 17,98 | sand boils |
| 677 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,18 | 13,11 | Colloredo di Monte Albano-Lauzzara- Mels | 17,17 | 18,09 | ground cracks water sand ejcetion |
| 678 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,224 | 13,049 | Osoppo- Molino del Cucco | 19,69 | 20,50 | sand boils |
| 679 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,181 | 13,088 | Majano- Pers | 18,57 | 19,42 | ground cracks |
| 680 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,221 | 13,068 | Osoppo- Rivoli di Osoppo | 18,35 | 19,21 | liquefaction |
| 681 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,229 | 13,115 | Buia- San Floreano | 14,62 | 15,69 | liquefaction |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 682 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,32 | 13,05 | Trasaghis-Alesso | 20,20 | 20,98 | liquefaction |
| 683 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,282 | 13,075 | Trasaghis | 17,36 | 18,28 | sand boils |
| 684 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,214 | 13,09 | Tomba di Buia (F.Tagliamentuzzo) | 16,94 | 17,87 | liquefaction |
| 685 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,213 | 13,091 | Tomba di Buia (Rio Gelato) | 16,90 | 17,84 | Liquefaction |
| 686 | Italy | 1976.05.06 | Friuli | 46,262 | 13,299 | 6,45 | $M_w$ | 9_10 | 5,7 | 46,215 | 13,083 | Tomba di Buia | 17,42 | 18,33 | water sand ejection |
| 687 | Italy | 1976.09.15 | Friuli | 46,3 | 13,174 | 5,95 | $M_w$ | 8_9 | 11,3 | 46,29 | 13,05 | Trasaghis- Avasinis | 9,59 | 14,82 | ground cracks water sand ejection |
| 688 | Italy | 1976.09.15 | Friuli | 46,3 | 13,174 | 5,95 | $M_w$ | 8_9 | 11,3 | 46,206 | 13,043 | Majano- Colle Baracchino | 14,52 | 18,40 | ground cracks sand boils |
| 689 | Italy | 1976.09.15 | Friuli | 46,3 | 13,174 | 5,95 | $M_w$ | 8_9 | 11,3 | 46,316 | 13,102 | Bordano | 5,81 | 12,71 | liquefaction |
| 690 | Italy | 1976.09.15 | Friuli | 46,3 | 13,174 | 5,95 | $M_w$ | 8_9 | 11,3 | 46,176 | 13 | San Giacomo- Lago di Ragogna | 19,22 | 22,30 | ground cracks |
| 691 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,419 | 26,090 | 19 (Bucarest) | 159,21 | 184,13 | Liquefaction_sand_boil_&_open_cracks |
| 692 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,930 | 26,039 | 1 | 212,40 | 231,67 | unspecified |
| 693 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,889 | 25,968 | 2 | 218,34 | 237,13 | unspecified |
| 694 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,764 | 23,889 | 3 | 318,05 | 331,23 | unspecified |
| 695 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,779 | 23,890 | 4 | 316,81 | 330,03 | unspecified |
| 696 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,241 | 24,262 | 5 | 259,81 | 275,78 | unspecified |
| 697 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,133 | 23,944 | 6 | 286,82 | 301,37 | unspecified |
| 698 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,728 | 24,820 | 7 | 273,97 | 289,16 | unspecified |
| 699 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,781 | 24,785 | 8 | 270,64 | 286,02 | unspecified |
| 700 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,783 | 24,572 | 9 | 280,49 | 295,35 | unspecified |
| 701 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,767 | 24,450 | 10 | 287,91 | 302,40 | unspecified |
| 702 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,736 | 25,218 | 11 | 256,92 | 273,07 | unspecified |
| 703 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,685 | 25,288 | 12 | 259,43 | 275,43 | unspecified |
| 704 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,638 | 25,390 | 13 | 260,69 | 276,61 | unspecified |
| 705 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,827 | 25,412 | 14 | 240,87 | 258,02 | unspecified |
| 706 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,827 | 25,485 | 15 | 238,38 | 255,70 | unspecified |
| 707 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 43,757 | 25,518 | 16 | 244,43 | 261,35 | unspecified |
| 708 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,297 | 25,919 | 17 | 176,67 | 199,42 | unspecified |
| 709 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,230 | 26,438 | 18 | 173,15 | 196,31 | unspecified |
| 710 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 44,554 | 27,291 | 20 | 141,52 | 169,07 | unspecified |
| 711 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 45,116 | 27,357 | 21 | 86,38 | 126,56 | unspecified |
| 712 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 45,150 | 27,333 | 22 | 82,18 | 123,73 | unspecified |
| 713 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 45,105 | 27,192 | 23 | 81,29 | 123,14 | unspecified |
| 714 | Romania | 1977.03.04 | Vrancea | 45,770 | 26,760 | 7,4 | $M_w$ | 9 | 92,5 | 45,689 | 27,520 | 24 | 59,69 | 110,09 | unspecified |
| 715 | Italy | 1978.04.15 | Patti Gulf | 38,385 | 15,086 | 6,03 | $M_w$ | 8 | 17,9 | 38,124 | 15,06 | Oliveri | 29,12 | 34,18 | B1 |
| 716 | Greece | 1978.06.20 | Stivos | 40,71 | 23,27 | 6,2 | $M_w$ | 8 | 3 | | | Stivos | 10,00 | 10,44 | A2 |
| 717 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,427 | 18,769 | Kotor | 51,58 | 53,20 | Liquefaction & lateral spreading |
| 718 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,451 | 18,575 | Zelenica | 62,93 | 64,26 | Liquefaction & lateral spreading |
| 719 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,088 | 19,100 | Bar port | 7,96 | 15,24 | Liquefaction & lateral spreading |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 720 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 41,877 | 19,379 | Pulaj | 30,11 | 32,79 | Failure of river bank |
| 721 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,006 | 19,421 | Obot | 29,04 | 31,81 | Failure of river bank |
| 722 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,026 | 19,518 | Beltoje | 37,02 | 39,24 | Failure of river bank |
| 723 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 41,863 | 19,442 | Velipoja | 35,39 | 37,70 | Ground subsidance & sand boil |
| 724 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 41,993 | 19,399 | Dajc | 27,36 | 30,29 | Ground subsidance & sand boil |
| 725 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | | | Mushan | 41,50 | 43,49 | A2 |
| 726 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | | | Tivat | 73,00 | 74,15 | A1, A2, B2, B3 |
| 727 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | | | Bar | 25,00 | 28,18 | B2, B3 |
| 728 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | | | Lezha | 55,00 | 56,52 | B7 |
| 729 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,467 | 18,675 | Kamenari | 59,41 | 60,82 | Liquefaction Road failure |
| 730 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,450 | 18,653 | Bijela port | 58,88 | 60,30 | liquefaction, port and shipyard facilities damaged |
| 731 | Montenegro | 1979.04.15 | Montenegro | 42,020 | 19,070 | 6,7 | $M_w$ | 9_10 | 13 | 42,015 | 19,434 | Obot | 30,08 | 32,77 | sinking of water well |
| 732 | Greece | 1980.07.09 | Almiros | 39,290 | 22,910 | 6,2 | $M_w$ | 8 | 47 | 39,188 | 22,824 | Almyros | 13,55 | 48,91 | Unspecified |
| 733 | Greece | 1980.07.09 | Almiros | 39,290 | 22,910 | 6,2 | $M_w$ | 8 | 47 | 39,278 | 22,826 | Nea Anchialos | 7,35 | 47,57 | Unspecified |
| 734 | Greece | 1980.07.09 | Almiros | 39,290 | 22,910 | 6,2 | $M_w$ | 8 | 47 | 39,268 | 22,815 | Nea Anchialos2 | 8,54 | 47,77 | Unspecified |
| 735 | Greece | 1980.07.09 | Almiros | 39,290 | 22,910 | 6,2 | $M_w$ | 8 | 47 | 39,243 | 22,812 | Dimitriada | 9,93 | 48,04 | Unspecified |
| 736 | Greece | 1980.07.09 | Almiros | 39,290 | 22,910 | 6,2 | $M_w$ | 8 | 47 | 39,344 | 22,935 | Volos | 6,38 | 47,43 | Unspecified |
| 737 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,783 | 15,233 | Calabritto- Alto Sele | 16,60 | 20,49 | Ground cracks |
| 738 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,666 | 15,333 | Buccino | 9,40 | 15,24 | Ground cracks water sand ejection |
| 739 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,898 | 15,434 | Calitri | 19,43 | 22,83 | Liquefation |
| 740 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,816 | 15,1 | Acerno- Lago Laceno | 28,36 | 30,79 | liquefaction |
| 741 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,867 | 15,167 | Lioni- SS 7 Ofantina | 26,18 | 28,80 | Ground cracks water sand ejection |
| 742 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 41,033 | 15,033 | Montecalvo Irpino | 46,99 | 48,50 | Ground cracks water sand ejection |
| 743 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,738 | 15,491 | Muro Lucano | 6,67 | 13,73 | Ground cracks water sand ejection |
| 744 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,744 | 15,492 | Muro Lucano | 6,94 | 13,86 | Ground cracks water sand ejection |
| 745 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,767 | 15,465 | Muro Lucano | 6,43 | 13,61 | Ground cracks water sand ejection |
| 746 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,717 | 15,183 | Senerchia | 19,49 | 22,89 | Liquefaction |
| 747 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,629 | 14,864 | Pontecagnano- Torre Picentina | 47,58 | 49,07 | ground cracks water sand ejection |
| 748 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,85 | 15,533 | Ruvo del Monte | 17,23 | 21,00 | ground cracks water sand ejection |
| 749 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 41,269 | 14,918 | San Giorgio La Molara- Masseria Marciano | 73,54 | 74,51 | ground cracks water sand ejection subsidence |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 750 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,767 | 14,583 | S. Marzano del Sarno | 70,19 | 71,21 | liquefaction |
| 751 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,893 | 14,856 | S. Michele di Serino | 50,60 | 52,00 | ground cracks water sand ejection subsidence |
| 752 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,873 | 14,862 | S. Michele di Serino (R. Sabato) | 49,34 | 50,78 | water sand ejection |
| 753 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,893 | 14,859 | S. Michele di Serino (R. Sabato) | 50,36 | 51,77 | water sand ejection |
| 754 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 41,76 | 14,949 | Scafati | 121,62 | 122,21 | ground cracks sand boils |
| 755 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 41,062 | 15,116 | Sturno | 45,18 | 46,75 | liquefaction |
| 756 | Italy | 1980.11.23 | Irpinia-Basilicata | 40,724 | 15,414 | 6,81 | $M_w$ | 10 | 12 | 40,881 | 14,949 | Valturara Irpina- P. del Dragone | 42,87 | 44,52 | ground cracks water sand ejection |
| 757 | Greece | 1981.02.24 | Alkionides | 38,230 | 22,970 | 6,4 | $M_w$ | 9 | 18 | 37,931 | 22,891 | Archeo Limani | 33,97 | 38,44 | Unspecified |
| 758 | Greece | 1981.02.24 | Alkionides | 38,230 | 22,970 | 6,4 | $M_w$ | 9 | 18 | 38,057 | 23,103 | Mavrolimni | 22,49 | 28,80 | Unspecified |
| 759 | Greece | 1981.02.24 | Alkionides | 38,230 | 22,970 | 6,4 | $M_w$ | 9 | 18 | 38,105 | 23,220 | Psatha | 25,91 | 31,55 | Unspecified |
| 760 | Greece | 1981.03.04 | Alkionides | 38,2 | 23,25 | 6,5 | $M_w$ | 9 | 18 | | | Kalamaki | 11,80 | 21,52 | C |
| 761 | Greece | 1988.10.16 | Killini | 37,930 | 20,920 | 5,6 | $M_w$ | 8 | 25 | 37,935 | 21,142 | Killini | 19,48 | 31,70 | ground cracks |
| 762 | Greece | 1988.10.16 | Killini | 37,930 | 20,920 | 5,6 | $M_w$ | 8 | 25 | 37,808 | 21,232 | Bouka killini | 30,57 | 39,49 | Unspecified |
| 763 | Italy | 1990.12.13 | South-Eastern Sicily | 37,306 | 15,429 | 5,61 | $M_w$ | 10 | 10 | 37,231 | 15,221 | Augusta | 20,21 | 22,55 | B1 |
| 764 | Turkey | 1992.03.13 | Erzincan | 39,710 | 39,610 | 6,7 | $M_w$ | 9 | 27 | 39,664 | 39,677 | Altinbasak_railway | 7,69 | 28,07 | Liquefaction railway failure |
| 765 | Turkey | 1992.03.13 | Erzincan | 39,710 | 39,610 | 6,7 | $M_w$ | 9 | 27 | 39,730 | 39,626 | Eksisu | 2,56 | 27,12 | Liquefaction road failure |
| 766 | Greece | 1992.03.20 | Milos Isle | 36,660 | 24,490 | 5,2 | $M_w$ | 6 | 11 | 36,687 | 24,445 | Hivadolimni | 5,01 | 12,09 | ground cracks and water ejection |
| 767 | Greece | 1995.05.13 | Kozani | 40,170 | 21,690 | 6,3 | $M_w$ | 9 | 14 | 40,071 | 21,824 | Kozani | 15,85 | 21,15 | sand boil |
| 768 | Greece | 1995.05.13 | Kozani | 40,16 | 21,67 | 6,3 | $M_w$ | 9 | 14 | | | Polifitos Lake | 18,00 | 22,80 | A2 |
| 769 | Greece | 1995.05.13 | Kozani | 40,16 | 21,67 | 6,3 | $M_w$ | 9 | 14 | | | Ryminio | 16,00 | 21,26 | B6 |
| 770 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Nikoleika | 25,00 | 25,50 | A1 |
| 771 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Meganitis r. | 25,00 | 25,50 | A1 |
| 772 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Rizomylos | 16,00 | 16,76 | A5 |
| 773 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Abythos | 8,00 | 9,43 | A5 |
| 774 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Eratini | 7,00 | 8,60 | B3 |
| 775 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | | | Selinitis r. | 10,00 | 11,18 | B7 |
| 776 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | 38,252 | 22,081 | Aegion Bay | 23,30 | 23,83 | liquefaction |
| 777 | Greece | 1995.06.15 | Aeghio | 38,400 | 22,270 | 6,3 | $M_w$ | 8 | 5 | 38,215 | 22,141 | Rizomylos | 23,46 | 23,98 | liquefaction |
| 778 | Turkey | 1995.10.01 | Dinar | 38,075 | 30,142 | 6 | $M_w$ | | 30,9 | 38,080 | 30,160 | 1 | 1,67 | 30,95 | lateral spreading |
| 779 | Turkey | 1995.10.01 | Dinar | 38,075 | 30,142 | 6 | $M_w$ | | 30,9 | 38,082 | 30,159 | 2 | 1,65 | 30,94 | sand boils |
| 780 | Turkey | 1995.10.01 | Dinar | 38,075 | 30,142 | 6 | $M_w$ | | 30,9 | 38,079 | 30,160 | 3 | 1,64 | 30,94 | sand boils |
| 781 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,902 | 35,565 | Abdiolgu_1 | 5,93 | 23,75 | lateral spreading |
| 782 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,914 | 35,574 | Abdioglu_school | 7,44 | 24,17 | v |
| 783 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,843 | 35,531 | Asmali_bridge | 1,86 | 23,08 | sand boils ground cracks |
| 784 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,820 | 35,469 | Esenler | 7,91 | 24,32 | sand boils ground cracks |
| 785 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,830 | 35,511 | Kutuklu | 4,18 | 23,38 | sand boils ground cracks |
| 786 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,850 | 35,584 | Guveloglu_1 | 3,04 | 23,20 | sand boils ground cracks |
| 787 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,856 | 35,583 | Guveloglu_2 | 2,98 | 23,19 | sand boils ground cracks |
| 788 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,876 | 35,589 | Kaslica | 4,53 | 23,44 | sand boils ground cracks |
| 789 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,878 | 35,568 | Buyukkapili | 3,48 | 23,26 | sand boils ground cracks |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 790 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,903 | 35,608 | Vayvayli | 7,80 | 24,29 | sand boils ground cracks |
| 791 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,939 | 35,593 | Gecitli | 10,57 | 25,31 | sand boils ground cracks |
| 792 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,958 | 35,624 | Misis | 13,66 | 26,75 | sand boils ground cracks |
| 793 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,992 | 35,699 | Cokca | 20,64 | 30,90 | sand boils ground cracks |
| 794 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 36,998 | 35,762 | Toktamis | 25,04 | 34,00 | sand boils ground cracks |
| 795 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,036 | 35,759 | Buyukmangit | 27,78 | 36,06 | sand boils ground cracks |
| 796 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,016 | 35,802 | Burhaniye | 28,98 | 37,00 | sand boils ground cracks |
| 797 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,034 | 35,794 | Ceyhan | 29,81 | 37,65 | sand boils ground cracks |
| 798 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,097 | 35,812 | Mercimek | 36,03 | 42,74 | sand boils ground cracks |
| 799 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,115 | 35,813 | Hamitbey | 37,57 | 44,05 | sand boils ground cracks |
| 800 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,142 | 35,829 | Adapinar | 40,78 | 46,82 | sand boils ground cracks |
| 801 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,170 | 35,843 | Inceyer | 44,10 | 49,74 | sand boils ground cracks |
| 802 | Turkey | 1998.06.27 | Adan-Ceyhan | 36,850 | 35,550 | 6,3 | $M_w$ | 9 | 23 | 37,182 | 35,900 | Dikilitas | 48,28 | 53,48 | sand boils ground cracks |
| 803 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,697 | 30,269 | Sapanca | 22,69 | 27,20 | Ground cracks sand boils buildings sank |
| 804 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,723 | 29,841 | Golcuk | 13,65 | 20,28 | subsidence |
| 805 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,778 | 30,375 | Adapazari | 32,77 | 36,04 | buildings sank |
| 806 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,745 | 30,389 | Adapazari2 | 33,17 | 36,40 | buildings sank |
| 807 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,710 | 29,500 | Altinova | 42,17 | 44,76 | Unspecified |
| 808 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,695 | 29,386 | Taskopru | 51,78 | 53,91 | Unspecified |
| 809 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,715 | 30,415 | Adapazari3 | 35,03 | 38,11 | buildings sank |
| 810 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 40,702 | 30,595 | Akyazi | 50,17 | 52,37 | Unspecified |
| 811 | Turkey | 1999.08.17 | Kocaeli | 40,700 | 30,000 | 7,5 | $M_w$ | 10 | 15 | 41,118 | 30,574 | Black sea cost | 67,00 | 68,66 | Unspecified |
| 812 | Turkey | 2002.02.03 | Cay-Eber | 38,610 | 31,080 | 6,6 | $M_w$ | | 12 | 38,638 | 30,916 | Kadikoy | 14,59 | 18,89 | Lateral spreading |
| 813 | Turkey | 2002.02.03 | Cay-Eber | 38,610 | 31,080 | 6,6 | $M_w$ | | 12 | 38,611 | 30,908 | Maltepe 1 | 14,95 | 19,17 | Unspecified |
| 814 | Turkey | 2002.02.03 | Cay-Eber | 38,610 | 31,080 | 6,6 | $M_w$ | | 12 | 38,608 | 30,908 | Maltepe2 | 14,95 | 19,17 | Unspecified |
| 815 | Turkey | 2002.02.03 | Cay-Eber | 38,610 | 31,080 | 6,6 | $M_w$ | | 12 | 38,600 | 30,895 | Maltepe3 | 16,12 | 20,09 | Unspecified |
| 816 | Italy | 2002.10.31 | Molise | 41,716 | 14,893 | 5,74 | $M_w$ | 7_8 | 25,2 | 41,74 | 14,507 | Salcito | 32,15 | 40,85 | Ground cracks |
| 817 | Turkey | 2003.03.01 | Bingol | 38,990 | 40,460 | 6,4 | $M_w$ | | 8 | 39,051 | 40,300 | Yaygincayir | 15,39 | 17,35 | Lateral spreading |
| 818 | Turkey | 2003.03.01 | Bingol | 38,990 | 40,460 | 6,4 | $M_w$ | | 8 | 39,051 | 40,300 | Uguroba_stream | 15,39 | 17,35 | sand boils |
| 819 | Turkey | 2003.03.01 | Bingol | 38,990 | 40,460 | 6,4 | $M_w$ | | 8 | 38,881 | 40,525 | Bingol_Plain | 13,36 | 15,58 | sand boils |
| 820 | Turkey | 2003.03.01 | Bingol | 38,990 | 40,460 | 6,4 | $M_w$ | | 8 | 39,050 | 40,513 | Hanocayiri | 8,10 | 11,39 | Sand boils lateral spreading |
| 821 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,787 | 20,720 | Ligia port | 13,88 | 18,34 | lateral spreading |
| 822 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,712 | 20,715 | nydri port | 16,00 | 20,00 | lateral spreading |
| 823 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,629 | 20,606 | Vasiliki | 18,35 | 21,92 | lateral spreading |
| 824 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,846 | 20,717 | Lefkada castle | 14,96 | 19,18 | sand boil and lateral spreading |
| 825 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,832 | 20,709 | Lefkass port | 13,73 | 18,24 | sand boils |
| 826 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,834 | 20,682 | Lefkada1 | 11,65 | 16,73 | Unspecified |
| 827 | Greece | 2003.08.14 | Lefkas Isle | 38,790 | 20,560 | 6,2 | $M_w$ | 8 | 12 | 38,849 | 20,686 | Lefkada2 | 12,74 | 17,50 | Unspecified |
| 828 | Italy | 2004.11.24 | Garda occidentale | 45,685 | 10,521 | 4,99 | $M_w$ | 7_8 | 5,4 | 45,618 | 10,256 | Salò | 21,91 | 22,57 | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 829 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 38,150 | 21,538 | Alikes | 19,07 | 26,22 | sand boils |
| 830 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 38,152 | 21,564 | Kato_Achaia | 19,71 | 26,69 | sand boils |
| 831 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 38,147 | 21,560 | Kato_Achaia | 19,07 | 26,23 | sand boils |
| 832 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 37,898 | 21,514 | Roupakia | 9,13 | 20,18 | sand boils |
| 833 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 38,016 | 21,405 | Nisi | 10,04 | 20,61 | Liquefaction |
| 834 | Greece | 2008.06.08 | NW Peloponnesus | 37,980 | 21,510 | 6,4 | $M_w$ | | 18 | 37,906 | 21,520 | Kaliva | 8,28 | 19,81 | Liquefaction |
| 835 | Italy | 2009.04.06 | L'Aquila | 42,342 | 13,38 | 6,29 | $M_w$ | 9_10 | 8,3 | 42,325 | 13,48 | L'Aquila- Fiume Aterno | 8,44 | 11,84 | Sand boils lateral spreading |
| 836 | Italy | 2009.04.06 | L'Aquila | 42,342 | 13,38 | 6,29 | $M_w$ | 9_10 | 8,3 | 42,126 | 13,818 | Vittorito | 43,34 | 44,13 | water ejection |
| 837 | Italy | 2009.04.06 | L'Aquila | 42,342 | 13,38 | 6,29 | $M_w$ | 9_10 | 8,3 | 42,306 | 13,483 | Fossa | 9,37 | 12,52 | sand boils |
| 838 | Italy | 2009.04.06 | L'Aquila | 42,342 | 13,38 | 6,29 | $M_w$ | 9_10 | 8,3 | 42,336 | 13,475 | L'Aquila - Bazzano | 7,84 | 11,42 | liquefaction |
| 839 | Italy | 2009.04.06 | L'Aquila | 42,342 | 13,38 | 6,29 | $M_w$ | 9_10 | 8,3 | 42,336 | 13,474 | L'Aquila - Bazzano | 7,76 | 11,36 | liquefaction |
| 840 | Serbia | 2010.11.03 | Kraljevo | 43,743 | 20,708 | 5,4 | $M_w$ | 7_8 | 15,4 | 43,747 | 20,699 | Sirca_1 | 0,87 | 15,42 | sand boils ground cracks |
| 841 | Serbia | 2010.11.03 | Kraljevo | 43,743 | 20,708 | 5,4 | $M_w$ | 7_8 | 15,4 | 43,755 | 20,686 | Oplakic(Oplakić) | 2,24 | 15,56 | sand boils ground cracks |
| 842 | Serbia | 2010.11.03 | Kraljevo | 43,743 | 20,708 | 5,4 | $M_w$ | 7_8 | 15,4 | 43,761 | 20,673 | Sirca_2 | 3,43 | 15,78 | Possible liquefaction |
| 843 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,986 | 43,309 | Celebibagi | 36,63 | 38,55 | Lateral spreading |
| 844 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 39,005 | 43,323 | Kasimbagi | 38,00 | 39,85 | sand boils |
| 845 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,635 | 43,258 | Teveliki | 21,70 | 24,80 | sand boils |
| 846 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,582 | 43,228 | Karasu_delta | 26,31 | 28,92 | sand boils |
| 847 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,598 | 43,218 | Citoren | 26,39 | 28,99 | sand boils |
| 848 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,977 | 43,329 | Celebibagi | 34,99 | 36,99 | sand boils |
| 849 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,599 | 43,244 | Topaktas | 24,27 | 27,07 | sand boils ground cracks |
| 850 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,673 | 43,246 | Alakoy | 21,93 | 25,00 | sand boils ground cracks |
| 851 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,864 | 43,476 | Lake beach | 19,33 | 22,75 | Sand boils lateral spreading |
| 852 | Turkey | 2011.10.23 | Van | 38,691 | 43,497 | 7,1 | $M_w$ | | 12 | 38,619 | 43,229 | Arisu | 24,64 | 27,41 | Liquefaction |
| 853 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,762 | 11,481 | Poggio Renatico | 22,68 | 24,59 | liquefaction |
| 854 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,912 | 10,984 | Concordia sulla Secchia | 22,08 | 24,04 | Liquefaction |
| 855 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,846 | 10,987 | Cavezzo | 22,45 | 24,37 | water sand ejection |
| 856 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,909 | 11,137 | Mirandola | 10,03 | 13,82 | sand boils |
| 857 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,845 | 11,140 | San Felice sul Panaro | 11,18 | 14,67 | sand water ejection |
| 858 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,841 | 11,167 | San Felice sul Panaro - Rivara | 9,67 | 13,55 | sand boils |
| 859 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,788 | 11,153 | Camposanto | 14,75 | 17,54 | liquefaction |
| 860 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,858 | 11,286 | Finale Emilia | 4,45 | 10,49 | sand boils |
| 861 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,832 | 11,473 | Vigarano Mainarda | 18,00 | 20,35 | liquefaction |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 862 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,855 | 11,484 | Vigarano Mainarda | 17,97 | 20,33 | water sand ejection |
| 863 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,770 | 11,526 | Poggio Renatico | 24,97 | 26,72 | sand boils |
| 864 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,922 | 10,672 | Guastalla | 46,66 | 47,62 | ground cracks sand boils |
| 865 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,809 | 11,448 | Mirabello | 17,46 | 19,88 | ground cracks sand boils |
| 866 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,809 | 11,407 | Sant'Agostino - San Carlo Chiesa | 14,85 | 17,63 | water sand ejection |
| 867 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,829 | 11,466 | Mirabello | 17,61 | 20,01 | sand boils |
| 868 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,725 | 11,316 | Pieve di Cento | 19,38 | 21,58 | water sand ejection |
| 869 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,791 | 11,289 | Cento - Dodici Morelli | 11,75 | 15,11 | liquefaction |
| 870 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,763 | 11,287 | Cento - Renazzo | 14,80 | 17,59 | liquefaction |
| 871 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,778 | 11,315 | Cento | 13,65 | 16,63 | water ejection |
| 872 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,806 | 11,402 | Sant'Agostino - San Carlo | 14,77 | 17,56 | sand boils |
| 873 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,958 | 10,969 | Quistello - Zambone | 24,17 | 25,97 | ground cracks sand boils |
| 874 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,803 | 11,377 | Sant'Agostino | 13,61 | 16,60 | water sand ejection |
| 875 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,941 | 10,923 | Sermide - Moglia | 27,26 | 28,87 | ground cracks sand boils |
| 876 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,906 | 11,317 | Bondeno | 4,44 | 10,48 | ground cracks sand boils |
| 877 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,796 | 11,381 | Sant'Agostino | 14,42 | 17,27 | ground cracks sand boils |
| 878 | Italy | 2012.05.20 | Pianura Emiliana | 44,895 | 11,263 | 6,09 | $M_w$ | 7 | 9,5 | 44,830 | 11,437 | Mirabello | 15,52 | 18,19 | ground cracks sand boils |
| 879 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,181 | 20,500 | Argostoli_Marina_2 | 5,07 | 17,17 | ground cracks |
| 880 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,211 | 20,439 | Lixourion_agios_spiridonas | 8,23 | 18,35 | ground cracks |
| 881 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,277 | 20,426 | Kefalonia_Lagune | 11,29 | 19,91 | ground cracks |
| 882 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,277 | 20,426 | Kefalonia_Lagune | 4,27 | 12,08 | ground cracks |
| 883 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,181 | 20,500 | Argostoli_Marina_3 | 5,07 | 17,17 | sand boils ground cracks |
| 884 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,212 | 20,439 | St_Gerssimos_Churc | 8,19 | 18,33 | ground cracks sand ejection |
| 885 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,190 | 20,412 | Soulari | 10,98 | 19,74 | Liquefaction |
| 886 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,199 | 20,439 | Ls-1 | 8,39 | 18,42 | sand boils ground cracks |
| 887 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,200 | 20,440 | Ls_2 | 8,37 | 18,41 | sand boils ground cracks |
| 888 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,199 | 20,439 | Ls_3 | 8,40 | 18,43 | sand boils ground cracks |
| 889 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,262 | 20,385 | Petani | 13,71 | 21,38 | Liquefaction |
| 890 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,157 | 20,385 | Ionan_sea_Hotel | 14,55 | 21,92 | Liquefaction |
| 891 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,182 | 20,489 | Argostoli_Port_1 | 5,59 | 17,33 | sand boils ground cracks |
| 892 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,180 | 20,490 | Argostoli_Port_2 | 5,72 | 17,37 | sand boils ground cracks |
| 893 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,176 | 20,491 | Argostoli_Municipal_Market | 6,03 | 17,47 | Liquefaction |
| 894 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,172 | 20,495 | Argostoli_Beach_park_1 | 6,18 | 17,52 | Liquefaction |
| 895 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,171 | 20,496 | Argostoli_Beach_park_2 | 6,18 | 17,53 | Liquefaction |
| 896 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,181 | 20,500 | Argostoli_Marina_1 | 5,07 | 17,17 | Liquefaction |
| 897 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,180 | 20,501 | Argostoli_Marina_4 | 5,11 | 17,18 | Liquefaction |
| 898 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,262 | 20,385 | Petani | 2,05 | 11,48 | Liquefaction |
| 899 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,157 | 20,385 | Ionan_sea_Hotel | 9,92 | 15,04 | Liquefaction |
| 900 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,177 | 20,390 | Chavriata | 13,24 | 21,08 | Possible liquefaction |
| 901 | Greece | 2014.01.26 | Cephalonia | 38,219 | 20,532 | 6 | $M_w$ | 7 | 16,4 | 38,209 | 20,438 | Lixouri | 8,27 | 18,37 | Possible liquefaction |
| 902 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,177 | 20,390 | Chavriata | 7,70 | 13,67 | Possible liquefaction |
| 903 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,181 | 20,500 | Argostoli_Marina_2 | 11,63 | 16,21 | ground cracks |
| 904 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,211 | 20,439 | Lixourion_agios_spiridonas | 5,43 | 12,54 | ground cracks |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 905 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,181 | 20,500 | Argostoli_Marina_3 | 11,63 | 16,21 | sand boils ground cracks |
| 906 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,212 | 20,439 | St_Gerssimos_Churc | 5,36 | 12,51 | ground cracks sand ejection |
| 907 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,190 | 20,412 | Soulari | 6,40 | 12,98 | Liquefaction |
| 908 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,199 | 20,439 | Ls-1 | 6,47 | 13,02 | sand boils ground cracks |
| 909 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,200 | 20,440 | Ls_2 | 6,42 | 13,00 | sand boils ground cracks |
| 910 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,199 | 20,439 | Ls_3 | 6,43 | 13,00 | sand boils ground cracks |
| 911 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,182 | 20,489 | Argostoli_Port_1 | 10,80 | 15,63 | sand boils ground cracks |
| 912 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,180 | 20,490 | Argostoli_Port_2 | 11,04 | 15,80 | sand boils ground cracks |
| 913 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,176 | 20,491 | Argostoli_Municipal_Market | 11,43 | 16,07 | Liquefaction |
| 914 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,172 | 20,495 | Argostoli_Beach_park_1 | 12,00 | 16,48 | Liquefaction |
| 915 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,171 | 20,496 | Argostoli_Beach_park_2 | 12,09 | 16,55 | Liquefaction |
| 916 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,181 | 20,500 | Argostoli_Marina_1 | 11,63 | 16,21 | Liquefaction |
| 917 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,180 | 20,501 | Argostoli_Marina_4 | 11,76 | 16,31 | Liquefaction |
| 918 | Greece | 2014.02.03 | Cephalonia | 38,246 | 20,396 | 5,9 | $M_w$ | 7 | 11,3 | 38,209 | 20,438 | Lixouri | 5,58 | 12,60 | Possible liquefaction |
| 919 | Greece | 2015.11.17 | Lefkas | 38,665 | 20,600 | 6,4 | $M_w$ | 8_9 | 10,7 | 38,631 | 20,601 | Vassiliki | 3,77 | 11,35 | sand boil |
| 920 | Greece | 2015.11.17 | Lefkas | 38,665 | 20,600 | 6,4 | $M_w$ | 8_9 | 10,7 | 38,710 | 20,713 | Nydri | 11,03 | 15,37 | sand boils ground cracks |

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## *Legend*

| Location Quality | |
|---|---|
| MTC | Main town coordinates |
| SC | Site coordinates |
| MC | Municipality coordinates |
| LC | Locality coordinates |
| | |
| A | georeferenced coordinates |
| B | coordinates obtained from maps |
| C | generic description of the site |

| Liquefaction Type | |
|---|---|
| Reference: Galli (2000) | |
| A | ground fissuring and related phenomena |
| A1 | only ground fissure |
| A2 | water emission |
| A3 | mud, sand and gravel venting |
| A4 | sand boils |
| A5 | mud volcaones |
| B | surface deformation |
| B1 | local settlement |
| B2 | local swelling |
| C | differential settlement of building |
| D | liquefaction evidence without description |

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**Liquefaction Type**

| Reference: DALO (Papathanassiou 2004) | |
|---|---|
| A1 | ground fissure with ejection of mud |
| A2 | sand boils |
| A3 | lateral spreading |
| A4 | settlement of the coast |
| B1 | settlement of building |
| B2 | tilting of building |
| B2,B3 | damages to builfdings and roads at the port/coast |
| B3 | settlement of quay/pier |
| B4 | lateral spreading of quay/pier |
| B5 | failure of ralway embankments |
| B6 | settlement of bridge |
| B7 | failure of river banks |
| B8 | damage to lifelines system |
| C | evidense/no classification |

| Reference: Pirrotta (2007) | |
|---|---|
| A | sand boils, sand hills and sand/mud volcanoes |
| B | ground deformation |
| B1 | ground fracturing |
| B2 | ground settlement |
| B3 | ground fracturing and settlement |
| C | ground deformation with material emission |
| C1 | ground fracturing with gases exhalation |
| C2 | ground fracturing with hot water, bituminous material and/or fluid emission and/or gases exhalation |
| C3 | ground fracturing and settlement with water and/or gases exhalation |