

The Unified Earthquake Catalogue of the Region

By

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1. Compilation of earthquake information.

The earthquake catalogue that is used in the assessment of earthquake hazards in the region and is used for evaluating the seismic hazard of the region and it covers the period 0-2000 AD. This catalog was compiled from the following sources:

- **Historical earthquake information is compiled from different Arabic, Islamic, Jewish and Christian historians who assembled descriptions of earthquakes mentioned in ancient literature such as Kashf As-Salsalah and Wasf Al-Zalzalah by As-Soyuti et al. (1882, 1964, 1971), which contains account of the historical earthquakes of the region from the seventh to the eighteenth century (Al-Sa'dani, 1971), in addition to the works of Iben Sina (1964), Ibn Taghribidri et al. (1967), Al-Gani (1978). These sources also contain detailed descriptions about damage and destruction (Al-Hakeem, 1988).**
- **Lists of historical earthquakes were also compiled from revised earthquake catalogs of the region and added after cross checking the quality and the authenticity of the data sources published. These data were compiled by Abu-Karaki (1987), Al-Tarazi (1992), Ambraseys (1971, 1978), Ambraseys and Melville (1988), Ambraseys and Barazangi (1989), Amiran et al. (1994), Ben-Menahem (1979), Ben Menahem and Aboodi (1981), El-Isa et al (1984), El-Isa et al (1985), El-Isa and Mustafa (1986), El-Isa and Hasweh (1988), Hasweh (1986), Poirier and Taher (1982), Salamon (1993), Shapira (1979), Shapira et al. (1993) and Turcotte and Arieh (1986) and many others.**
- **Instrumental data concerning earthquakes in our region are available from the beginning of the 20th century owing to the operation of seismic stations in Egypt (HLW), Lebanon (KSR), Israel (JER, EIL) and several tens of stations in Europe. Earthquake information for the period 1900-1982 is mainly available from the International Seismological Summary (ISS), England, the International Seismological Center (ISC), England, the National Earthquake Information Service (NEIS), USA, and the compilation of Arieh et al. (1985).**
- **Since 1982, earthquake information is available mainly by the national seismic networks operating in the region (see locations of stations on the map in Fig. 1). The Israel Seismic Network (ISN), was established in 1980 and is operated continuously by the Seismology Division of the Geophysical Institute of Israel (GII). The Jordanian Seismic Network (JSN) was established in 1986 and is operated continuously by the Jordanian Seismological Observatory, the Natural Resources Authority (NRA) of the Hashemite Kingdom of Jordan. The Cypriot network was installed in 1996. Sporadic data are**

available from Lebanon and Saudi Arabia mainly through the Joint Seismological Observation Program (JSOP) of the regional project for Reducing Earthquake Losses in the East Mediterranean Region (RELEMR).

All together, the seismicity of the Dead Sea Rift system is a unique example of an area for which information and documentation on historical earthquakes cover a time span of more than four millennia. Evidently, with respect to source parameters of the events, the period from which instrumental data became available is by far more reliable. Hence, the unified earthquake catalogue for the Dead Sea Rift system covers the 20th century (1900-1999). The map of epicenters of the 20th century is shown in Fig. 2.

2. Unification of the magnitude scale.

In the process of unifying the catalogue, we had to address the problem of unified magnitude determinations. Most of the events (including those measured during 1954-1982) have been assigned the ML value as determined by the recordings made by Israeli station according to the equation (Shapira, 1998):

$$M_L = -0.6 + 2 \log(\tau) + 0.0015R \quad (1)$$

The magnitudes of the earthquakes that are recorded by only the JSN are determined according to the formula:

$$M_L = 0.7 + 0.001(R) + 1.54 \log t \quad (2)$$

Where, t and τ are the duration of the signal and R is the distance (km) from the epicenter. The parameter τ corresponds to the duration of coda waves; from the arrival of the S waves and until the signal drops below a level of 0.5 micron/s.

Feldman et al. (1997), Shapira and Hofstetter (1993) and Vered-Malitzky (2002) correlated between ML (ISN), ML (JSN) and the seismic moment M_0 and obtained the correlations:

$$M_L = (0.97 \pm 0.02) \log(M_0) - (16.90 \pm 0.36) \quad \sigma(M) = 0.17 \quad (3)$$

$$\log(M_0) = (0.96 \pm 0.02) M_L + (17.59 \pm 0.05) \quad \sigma(\log M_0) = 0.17 \quad (4)$$

$$M_L = 1.01 + 0.66 M \text{ (Jordan)} \quad (5)$$

$$M_L = 1.11 + 0.61 M \text{ (Israel)} \quad (6)$$

These correlations are valid for the magnitude range 1.0 to 5.0. For higher moments, the magnitude is identified with the moment magnitude M_w , i.e., following Hanks and Kanamori (1979):

$$M_w = 0.66 \log(M_0) - 10.6 \quad (7)$$

These relationships are used to unify the local magnitude M_L . For earthquakes which occurred prior to 1956 or for which local seismograms were not available, we assumed that M_L is equal to the given magnitude value (usually M_s) for $M_L > 4.8$. The relationships given by equations 3 to 7 enable determination of the moment magnitudes for all events (as later required for assessing seismicity rates).

Based on the availability of earthquake data and following previous studies of Shapira et al. (1979), Shapira (1992), Marouani and Shapira (1993), Arieh and Rabinowitz (1989) and Steinberg and Rabinowitz (2001) we suggest that the earthquake information available for the Dead Sea Rift system or more precisely, to the rectangular region shown on the map in Fig. 3, is complete for the following periods and magnitudes as shown in Table 1:

Table 1: Completeness of earthquake information in the DS rift system

Period	Threshold Magnitude	Area	Comments
Since 100 AD	6.5	The whole region	Destructive earthquakes
Since 1000	6.0	The whole region	Damaging earthquakes
Since 1800	5.5	The whole region	Felt and reported
Since 1900	5.0	The whole region	Felt, reported and recorded
Since 1940	4.0	Within the DS rift	Felt, reported and recorded
Since 1964	3.0	Within the DS rift	Detected by the WWSSN
Since 1983	2.5	Within JSN & ISN	Detected by the ISN
Since 1986	2.0	Within JSN & ISN	Detected by the ISN & JSN

Fig. 1 : Seismic stations monitoring the seismic activity of the EMR.

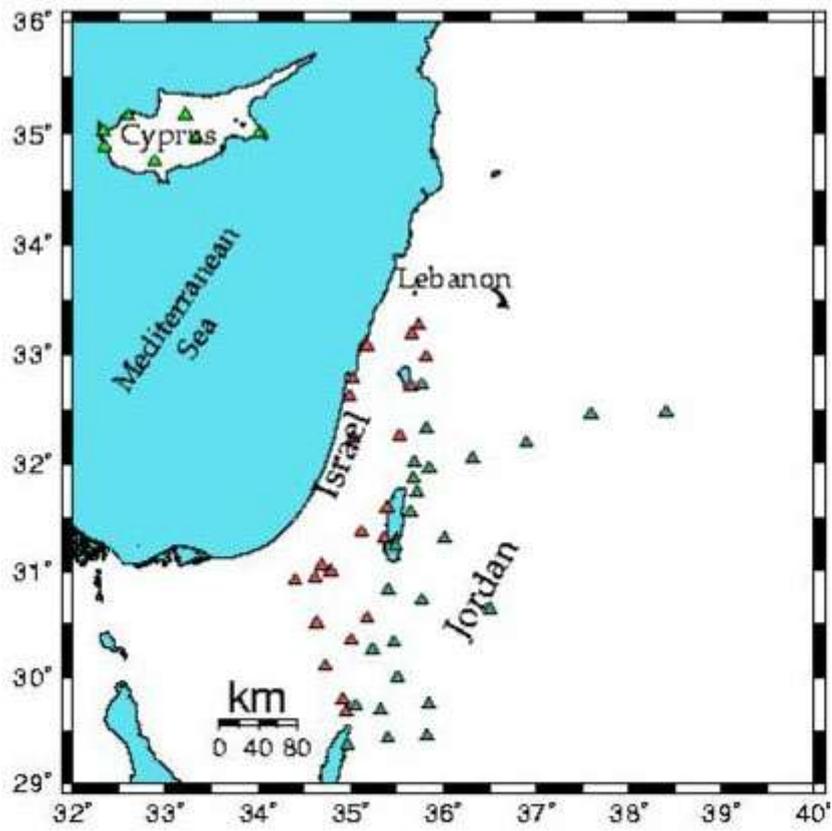


Fig. 2. Seismicity of the East Mediterranean and Middle East region 1900-1999.

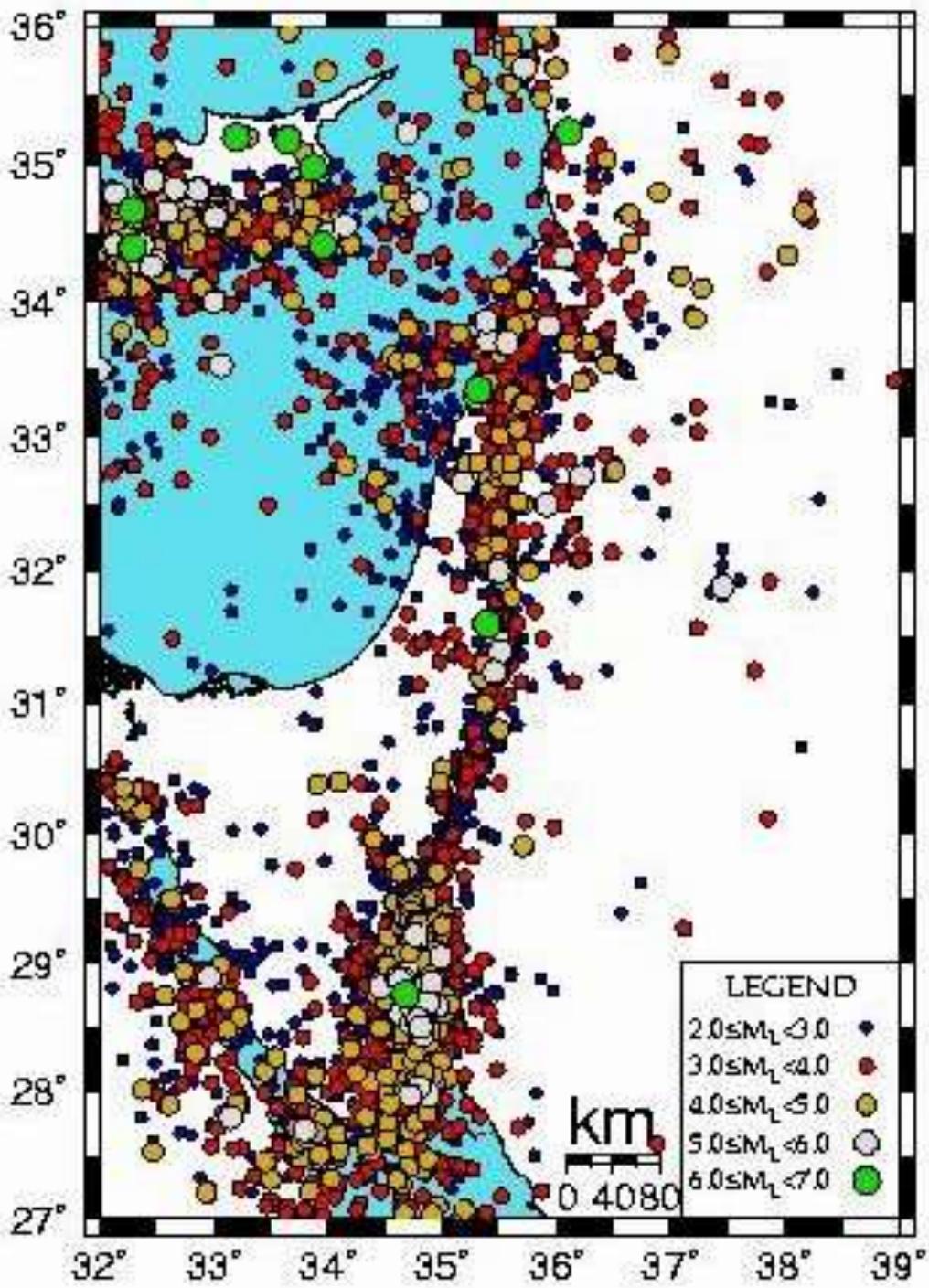


Fig. 3. The area where earthquake information is most complete.

