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Kahramanmaraş - Gaziantep Türkiye M7.7 Earthquake,
6 February 2023 (04:17 GMT+03:00)

Large historical earthquakes of the earthquake-affected
region: a preliminary report

K. Sesetyan (B.U. KOERI), M. Stucchi, V. Castelli and A.A. Gomez Capera (INGV, Istituto Nazionale di
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Introduction

The region where the 2023 February 6 earthquakes took place is known to have been very active in the past; it is part of the contact between the Eurasian and the Arabic plate, an area where seismic activity was relatively low in the 20th century (Figure 1). It is a “border zone” also from the historical point of view; therefore, although many earthquakes are known to most earthquake catalogues and compilations, the relevant information is often rather poor and affected by chronological and place-names problems. As a consequence, earthquake parameters given in the catalogues are often based on a poor dataset; the situation is even more complicated by chronological issues and careless compilations, which lead to earthquake duplications.

In the frame of a larger investigation effort underway (Sesetyan et al., 2020; Stucchi et al. 2022) we first considered the available information from the main earthquake catalogues and compilations in the time-window 1000-1900. The volume by Ambraseys (2009) summarizes and sometimes updates the knowledge already proposed in previous works such as Ambraseys and Jackson (1988), Ambraseys (1989), Ambraseys and Finkel (1995). We also considered the works by Soysal et al. (1981), Guidoboni et al. (2019), Sbeinati et al. (2005), some recent historical earthquake investigations and the parametric catalogues by Shebalin and Tatevossian (1997), Tan et al. (2008), Sesetyan et al. (2013). Next, we assessed - when possible - macroseismic intensities at the mentioned localities and, from them, we assessed earthquake parameters by making use of the so-called “Boxer” method by Gasperini et al. (1999).

For some of the main earthquakes in the region we briefly summarise here the earthquake parameters from our investigation and from the main catalogues. In the Appendix we summarise the available information.

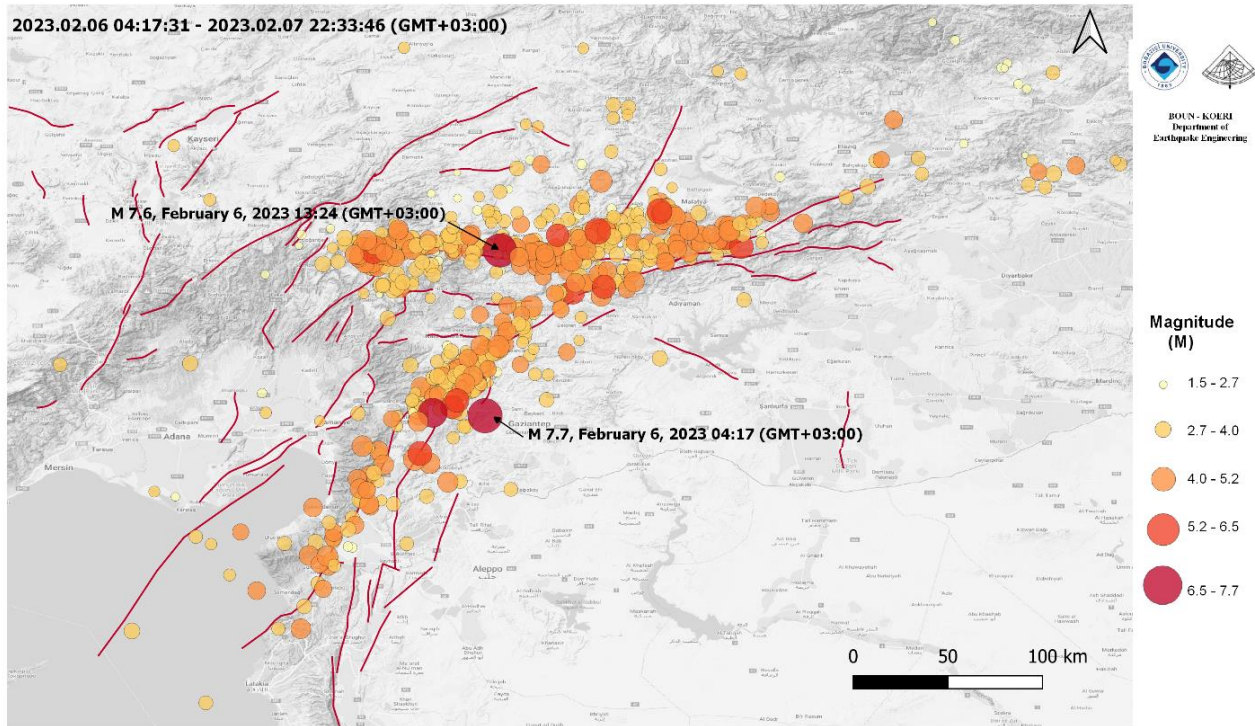


Figure 1. Earthquake activity between 06.02.2023 04:17 – 07.02.2023 22:33 (Figure from Hancılar et al., 2023); earthquake data from KOERI (<http://www.koeri.boun.edu.tr/sismo/2/en/>). Red lines represent fault data compiled from Active Fault Map of Turkey, MTA (Mineral Research & Exploration General Directorate, Emre et al. 2013).

Table 1. Main parameters of the main earthquakes in the investigated area in the time-window 1000-1900

Y	M	D	AREA	N MDP	LAT	LON	Mw	Unc	SOY (int)	SHETA Mw	SBE Mw	CFT Mw	TAN Mw	SES Mw	DUEM Mw
1003			al-Thughur	9			6.63	0.32	8					6.21	
1114	8	10	Antioch						9	8.0			8.1	6.77	
1114	11	13	Misis	2	36.954	35.600	6.63	0.32			7.4	7.8			6.3
1114	11	29	Antioch, Maraş	21	37.311	37.423	7.75	0.42			7.7			6.21	
1138	10	11	Atharib	10	35.844	36.680	7.18	1.13	8	7.4	7.4	7.5	7.4		
1269	5		Sis	8	36.936	36.265	7.22	0.46				6.4			6.3
1344	1	3	Aintab	9	37.265	37.907	7.55	0.43	7	7.6	6.8	7.3			
1514			Malatya, Adana	3	37.500	36.500			7				7.5		7.4
1544	1		Zeytun	4	38.034	36.995	7.00	0.75	8	6.4			6.8	6.21	6.8
1795			Maraş	1	37.577	36.928	6.63	0.32							
1822	8	13	Antakya	47	36.391	36.841	7.74	0.38	9		7.0			7.43	7.5
1872	4	3	Amik Golu	33	36.131	36.015	7.01	0.52	9		5.9			7.15	7.2
1893	3	2	Malatya	49	38.154	38.293	6.84	0.45		7.0			7.1	7.10	7.1

Y = year; M = month; D = day; Area = most damaged area; NMDP = number of macroseismic data points; LAT, LON = latitude, longitude of the epicentre (this study); Mw, Unc = Mw and uncertainty (this study); SOY (int) = Intensity by Soysal et al, 1981; SHETA Mw = Mw from Shebalin and Tatevossian (1987); SBE Mw = Mw from Sbeinati et al. (2005); CFT Mw = Mw from Guidoboni et al. 2019; TAN Mw = Mw from Tan et al. (2008); SES Mw = Mw from Sesetyan et al. (2013); DUEM Mw = Mw from Duman and Emre (2013).

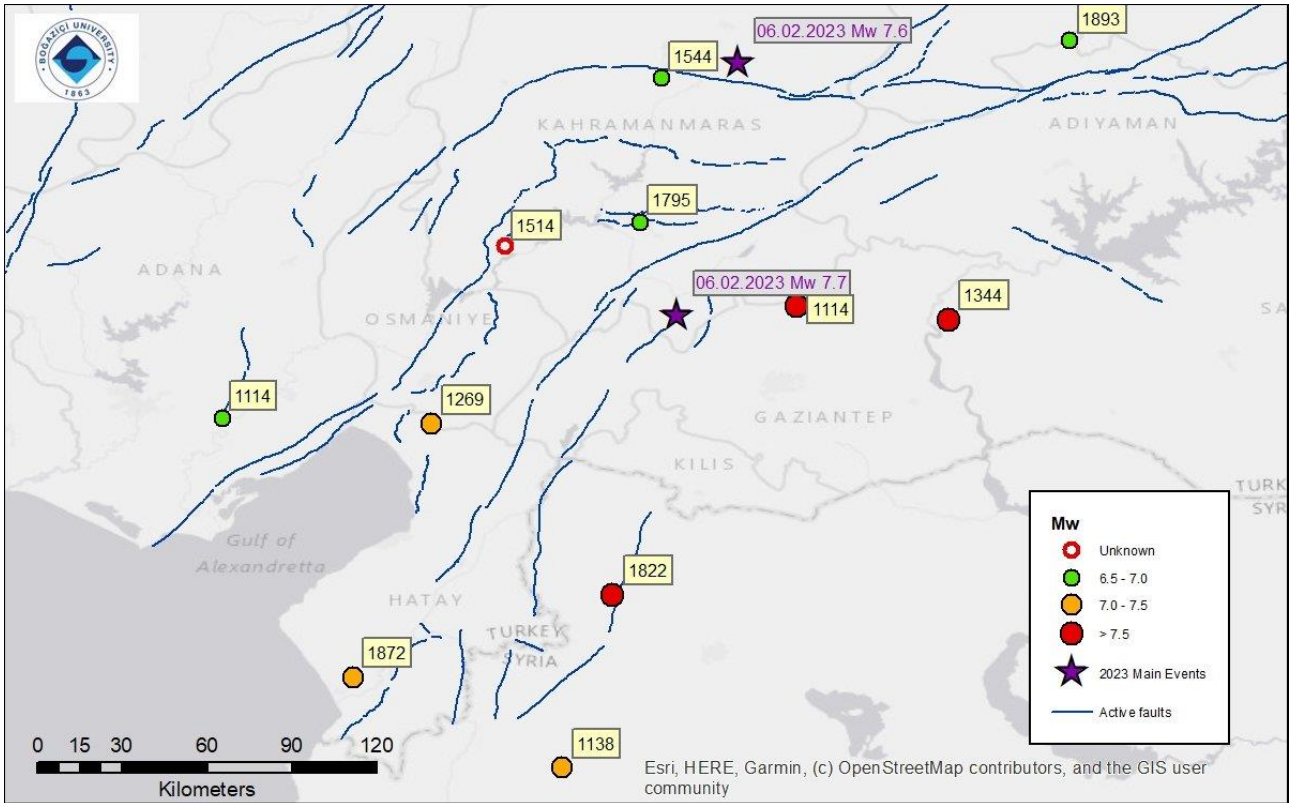


Figure 2. Estimated epicentral locations of the earthquakes in the time-window 1000-1900

Appendix

1003

According to Ambraseys (2009), in this year an earthquake affected many fortifications in the in the frontier regions of al-Wasim and al-Thughr, that is in the south-western terminus of the East-Anatolian Fault (EAF). This earthquake might have been very large; location and size are to be taken as rather preliminary (Figure 3).

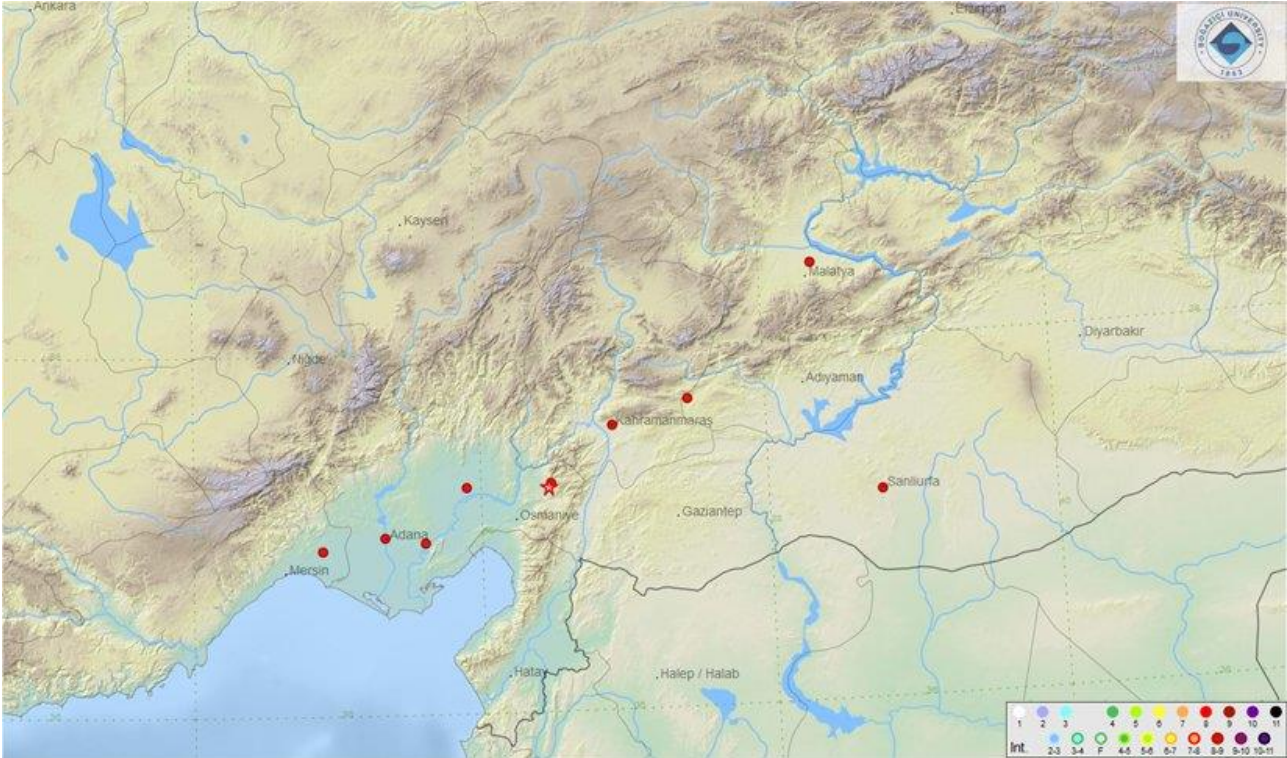


Figure 3. Macroseismic data points (MDPs) and preliminary epicentral location (red star) assessed for the 1003 earthquake

1114

The understanding of the 1114 earthquakes is rather complicated. At least three damaging earthquakes are known from the catalogues to have hit the region on August 10, November 13 and 29. All of them are accounted for by reliable sources; there remain some disagreement concerning the dates and the size. According to Ambraseys (2009) the first one caused damage to Alexandretta (Iskenderun), but it could have been originated offshore.

The earthquake of November 13 mainly damaged Mamistra (Misis) and surrounding villages. As for the third one the most damaged area was around Maras (Kahramanmaraş) and extended to Antioch (Hatay), Aleppo and Edessa (Şanlıurfa). The M_w we calculate is similar to the one of the first event of February 6, 2023. As seen in Table 1, some catalogues assign the largest magnitude (a very large one) of the sequence to the first earthquake, although the proposed location corresponds to the one of November 13.

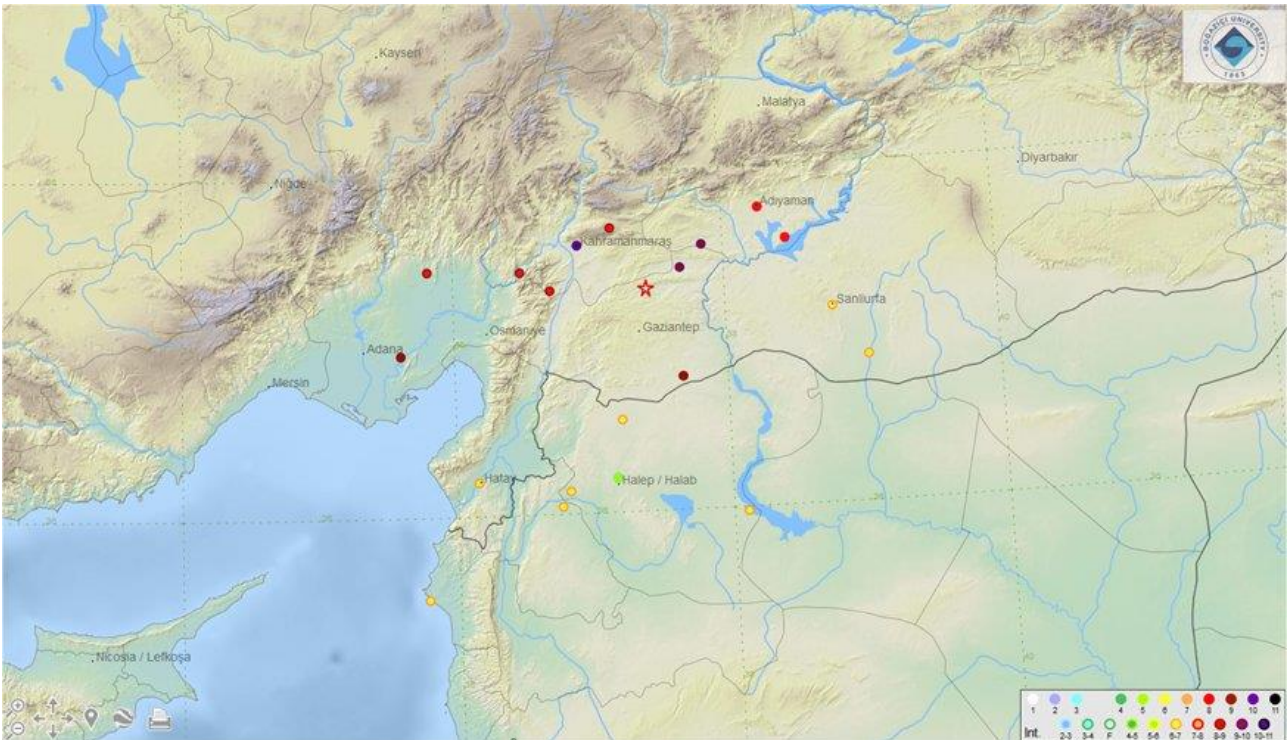


Figure 4. MDPs and epicentral location (red star) assessed for the 29 November 1114 earthquake

1138 October 11

This earthquake is accounted for by many historical sources. It affected the area south-east of the recent earthquake, with heaviest destructions in Atharib, west of Aleppo. It was felt as far as Damascus.

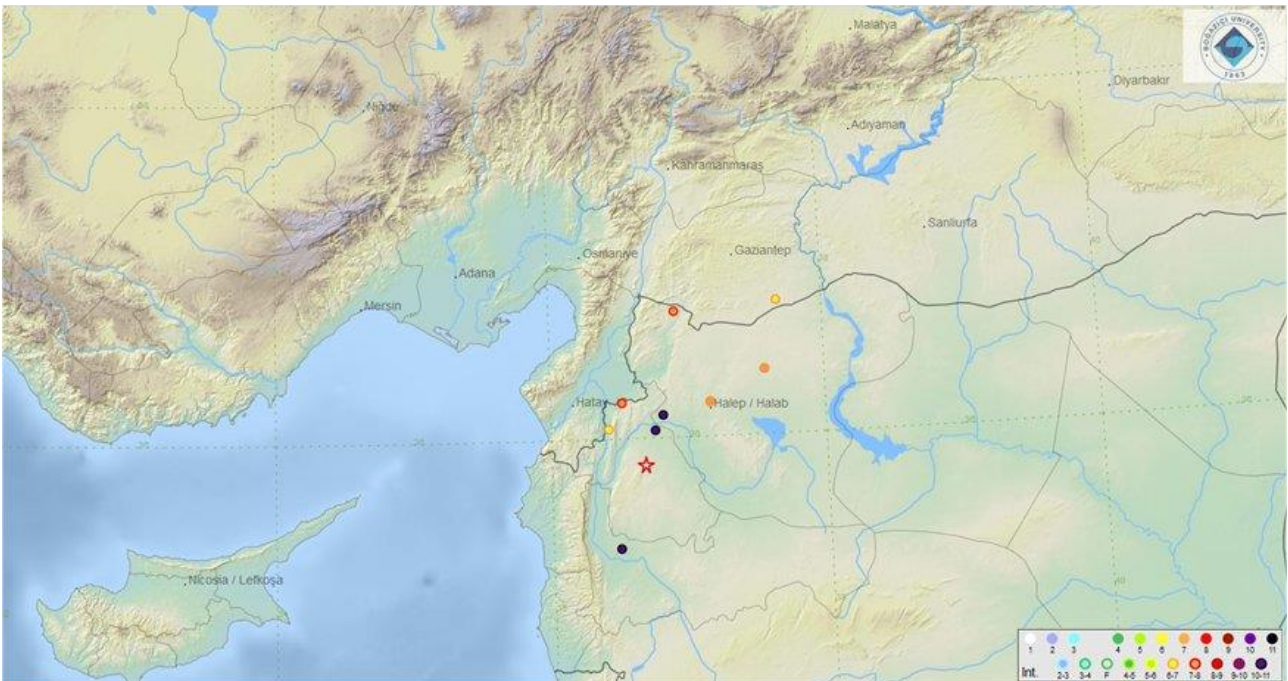


Figure 5. MDPs and epicentral location (red star) assessed for the 11 October 1138 earthquake

1269

The event of the year 1269 hit the historical region of Cilicia, with maximum damage in Toprakkale.

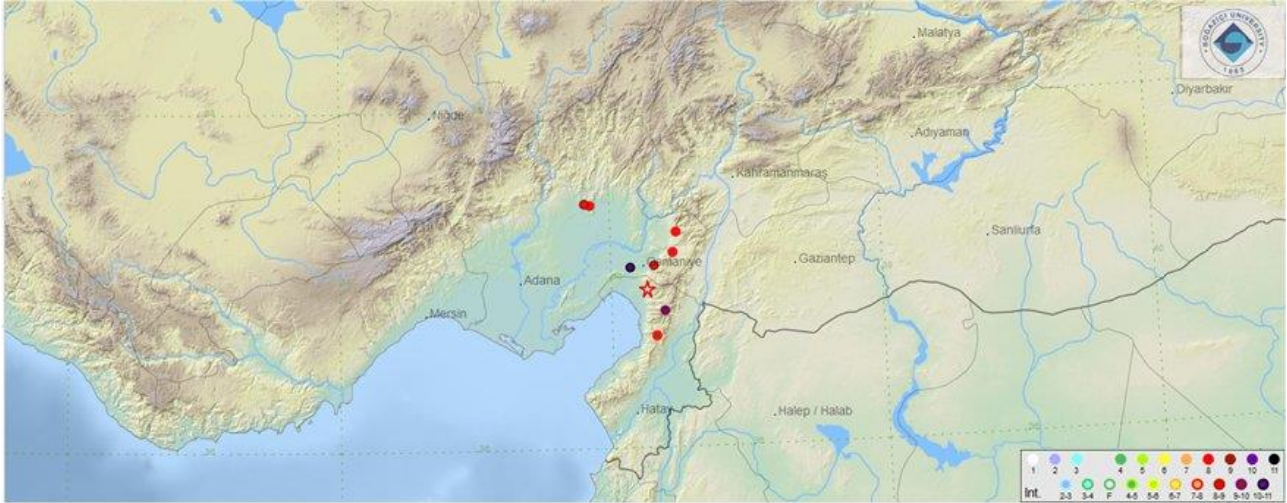


Figure 6. MDPs and epicentral location (red star) assessed for the earthquake of the year 1269

1344

This earthquake, a rather large one, is known from some catalogues as happened in 1343, although most sources indicate the year as 1344. It heavily affected the region extending from Gaziantep to Aleppo. It was also felt in Damascus.

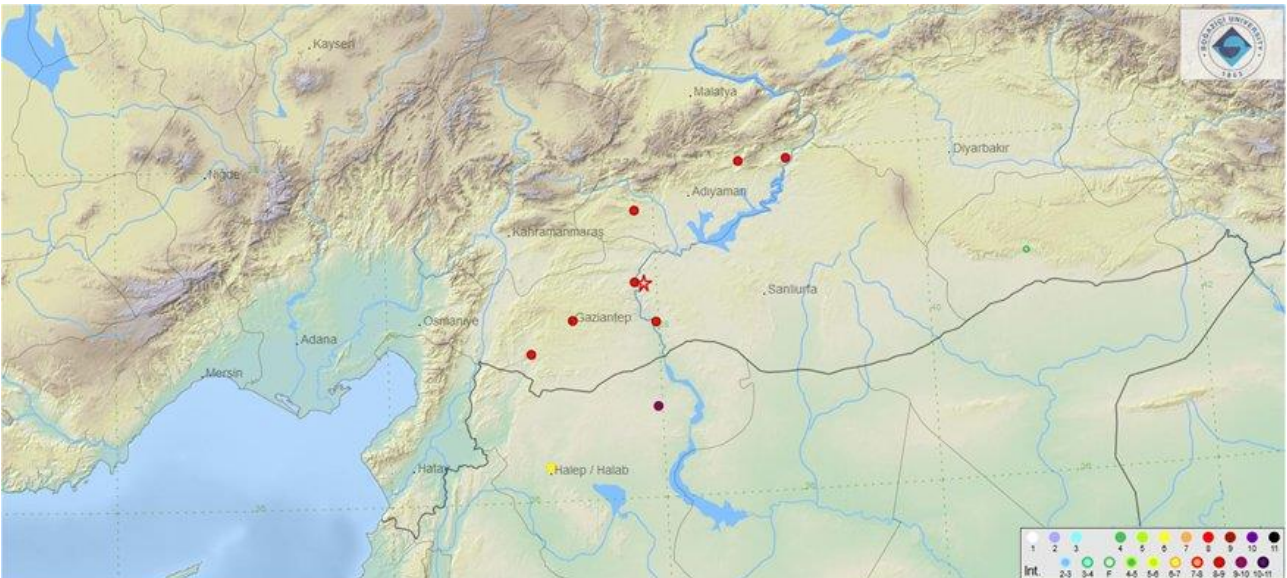


Figure 7. MDPs and epicentral location (red star) assessed for the earthquake of the year 1344

1514

This earthquake is mentioned in a letter, written in Damascus on 10 March 1514, which reports damage in Malatya, Tarsus and Adana. The letter was sent from Damascus to Cyprus, and from there to Venice, where it was fully transcribed in Sanudo (16th century, 1877).

Ambraseys (2009) concludes that “without further details this information is insufficient to indicate the precise date and area over which this earthquake was felt”.

1544 January

This event is well known to most catalogues and compilations. It affected Zeyton, today's Süleymanlı which also suffered from a landslide, and Elbistan and destroyed the aqueduct of Djedjin, also known as Kuweik River, located a few km south of Gaziantep, which supplied water to Aleppo (<https://archive.org/details/jstor-1798401/page/n1/mode/2up>). Although information is poor, this earthquake may be located in the area where the recent M7.6 took place.

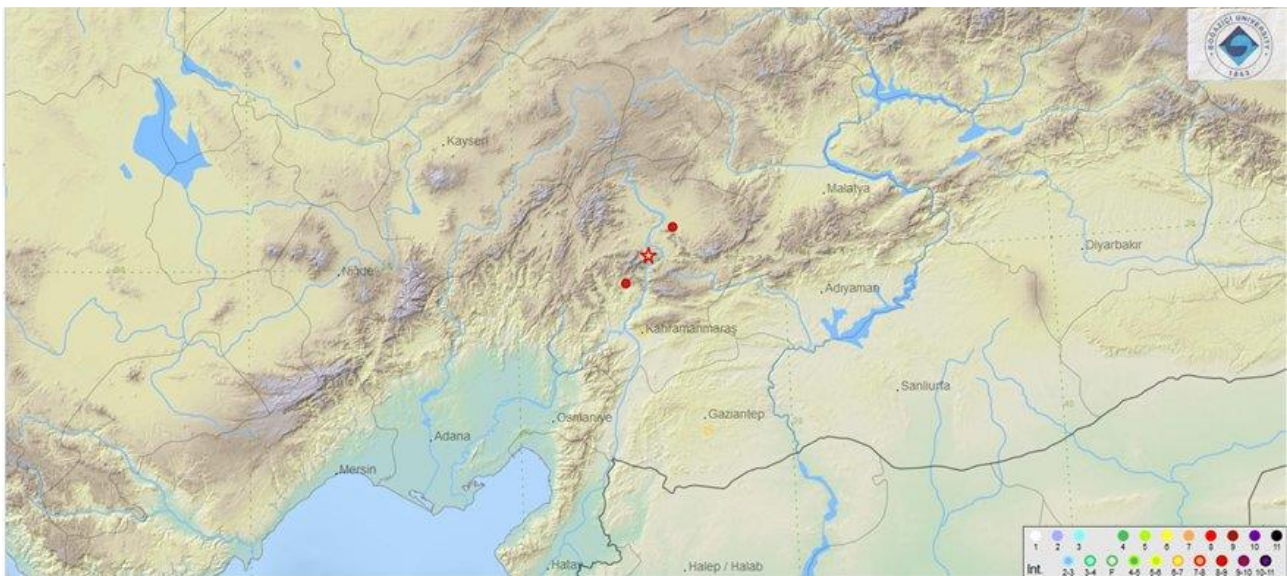


Figure 8. MDPs and epicentral location (red star) assessed for the earthquake of the year 1544

29 November 1795

The earthquake of 29 November 1795 was not known to any earthquake catalogue or compilation before it was “unearthed” by an investigator (Daş, 2005) who studied a manuscript in the Koyunoğlu Library in Konya; the transcription was given to two researchers of the Elazig University who published a paper on the earthquake (Palutoglu and Sasmaz, 2017). The source describes heavy damage in the city of Kahramanmaraş but, unfortunately, only there. It seems therefore difficult to assign, from a single data point, Mw 7.0 and an epicentre, although this one should not be located much far from the city.

Ambraseys and Finkel (1995) report two shocks felt in Aleppo in December 1795 at 14h10m., no day, the second one damaging. This information, coming from Olivier (1807), is then reported [misprinted in 1783] by Sbeinati (2005) and Ambraseys (2009).

If the chronological aspects could be solved, this information could be consistent with a strong earthquake somewhere along the EAF. In conclusion, we may have definitely a significant, new earthquake in the area, for which further investigation would be needed to assign realistic earthquake parameter.

13 August 1822

This earthquake is known from all catalogues and compilations as a very large one: a number of contemporary and near contemporary historical sources is available. It occurred at the junction of EAF with DSF; it was felt from the coast of the Black Sea to Gaza and was followed by a long sequence of aftershocks. The heaviest destructions were found in an area from Gaziantep to Hatay and Lattakya, with epicentral area located between Idlib and Aleppo. Recently it has been studied in detail by Darawcheh et al (2022), with special reference to damage to the city of Aleppo: their Mw assessment is similar to the one obtained by this study.

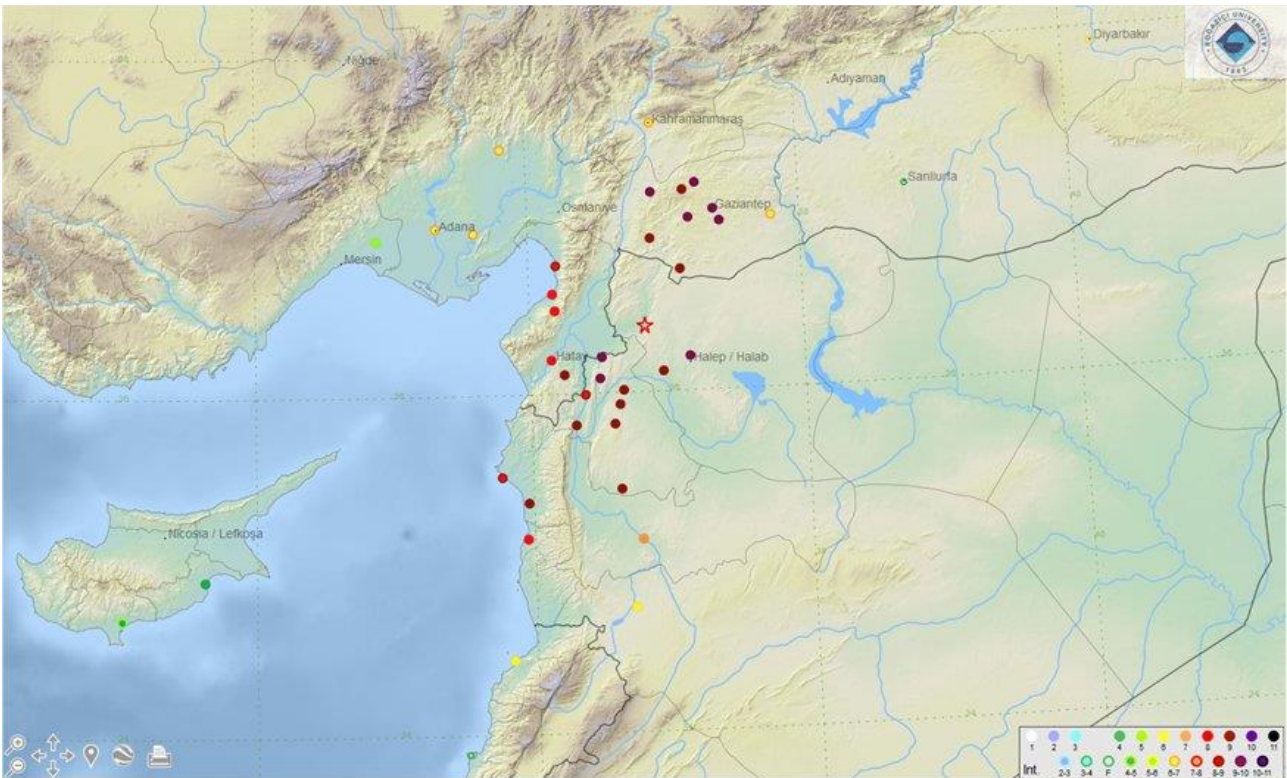


Figure 9. MDPs and epicentral location (red star) assessed for the earthquake of the 13 August 1822 earthquake

03 April 1872

The earthquake of the year 1872 mainly affected the area where the River Orontes flows into the Mediterranean Sea. It was felt over a wide area ranging from Rhodes to Diyarbakir and from Konya to Gaza. The city of Antakya (Hatay) was ruined. Liquefaction was observed. A tsunami followed which affected the coastal towns.



Figure 10. MDPs and epicentral location (red star) assessed for the earthquake of the 03 April 1872 earthquake

02 March 1893

This earthquake strongly affected the region just South of Malatya, in particular between Pütürge and Malatya. It was felt as far as Aleppo, Sivas, Zara and Lattakiya. It was among the first earthquakes instrumentally recorded in Rome (Rocca di Papa) and Strasbourg. The epicentral location remains slightly to the north of the February 2023 earthquakes.

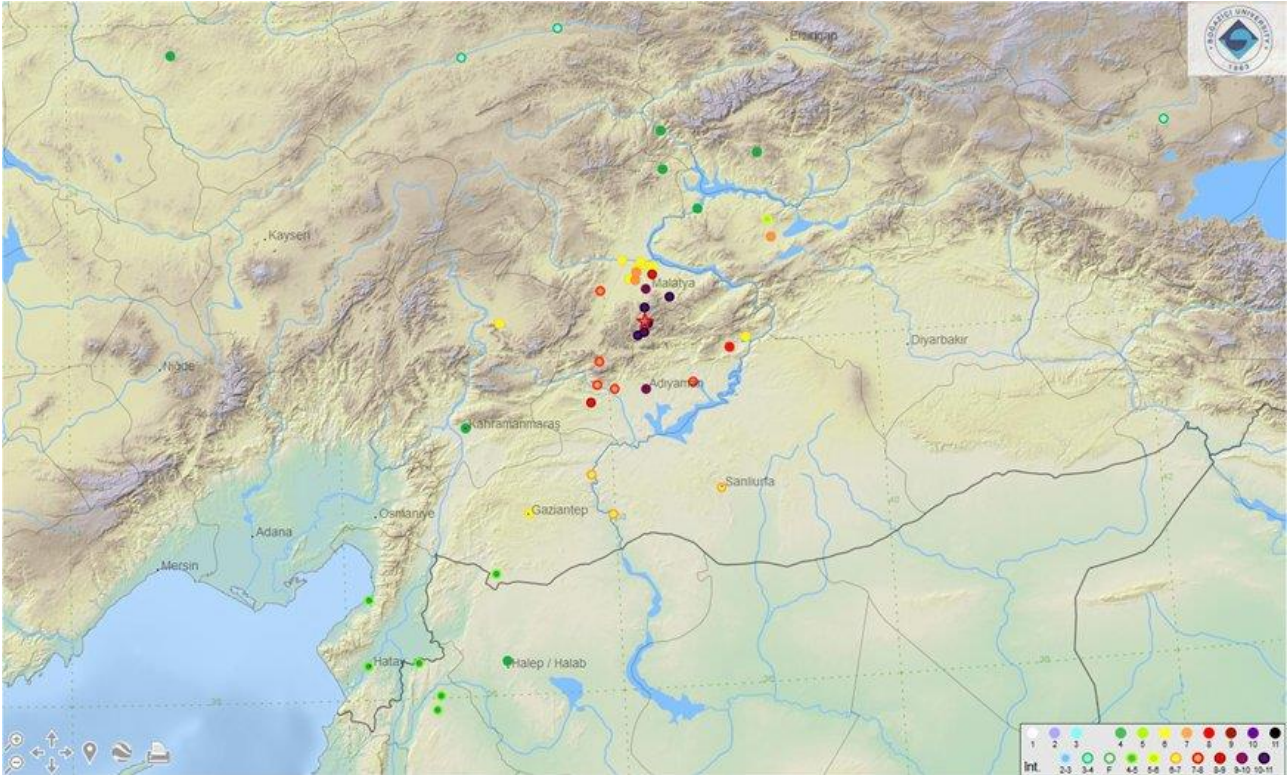


Figure 11. MDPs and epicentral location (red star) assessed for the earthquake of the 02 March 1893 earthquake

Acknowledgments

Fig. 3 to 11 come from the macroseismic data points viewer “MIDOP” (Locati and Cassera, 2010; <https://emidius.eu/MIDOP/>). Mario Locati and Mine B. Demircioğlu Tümsa are acknowledged for helping with the installation.

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