



Boğaziçi University
Kandilli Observatory and Earthquake Research Institute
Department of Earthquake Engineering

24 January 2020 (20:55)
Elazığ-Sivrice Earthquake

**Seismotectonics, Strong Ground Motion and Building
Damage Estimations
Preliminary Report**

25.01.2020

1. INTRODUCTION

On January 24th 2020, an important earthquake took place near the Sivrice district of the Elazığ province at 20:55:14 local time. The magnitude was reported to vary between 6.5-6.8 (Mw) by several institution. The earthquake is associated with the Pütürge segment of the East Anatolian Fault Zone. The rupture length is estimated between 20 and 30 km. This preliminary report summarizes early findings and information on the seismotectonics, strong ground motion characteristics and building damage estimations of Elazığ-Sivrice earthquake.

The report is prepared by the Department of Earthquake Engineering of Boğaziçi University's Kandilli Observatory and Earthquake Institute and can only be used if properly referenced.

2. EARTHQUAKE PARAMETERS

Date: 24.01.2020 Time: 17:55:14 (UTC)				
Reported by	KRDAE	AFAD	USGS	EMSC
Magnitude	Mw 6.5 MI 6.6	Mw 6.8	Mw 6.7	Mw 6.8
Coordinates	38.3775 N 39.1042 E	38.3626 N 39.2588 E	38.33 N 39.084 E	38.37 N 39.22 E
Depth (km)	4.8	6.75	10	15

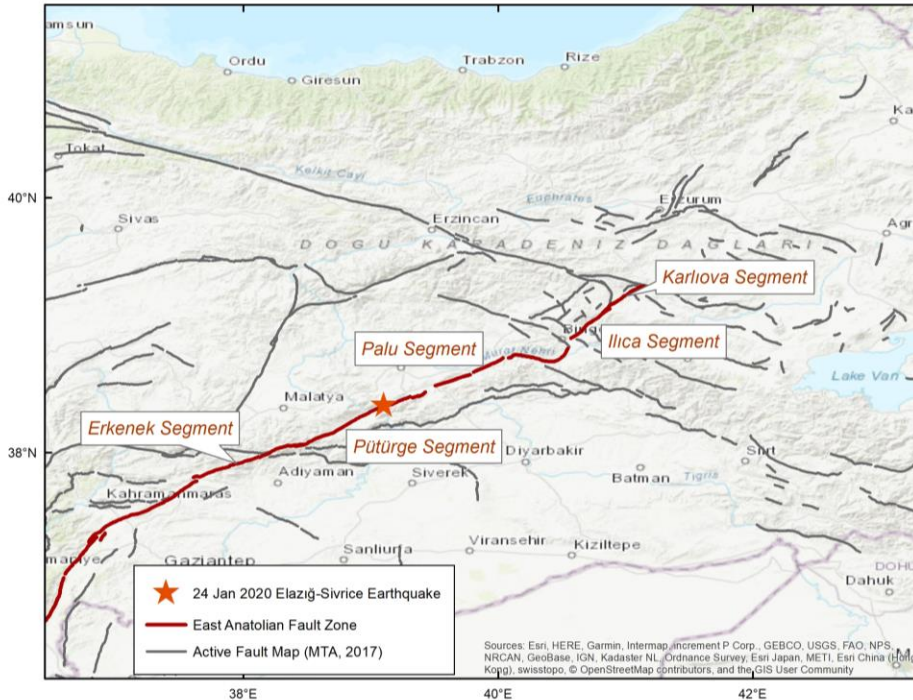


Figure 1. 24 January 2020 Elazığ-Sivrice Earthquake and its relation with the segments of the East Anatolian Fault Zone between Karlova and Osmaniye

Earthquake Mechanism

According to earthquake source information, and regional seismotectonics the earthquake is associated with the East Anatolian Fault Zone, has a left-lateral strike slip mechanism and took place on a fault plane hat has a dip angle of approximately 70 degrees.

Moment Tensor Solutions

www.globalcmt.org:



Date: 2020/ 1/24 Centroid Time: 17:55:24.6 GMT

Lat= 38.30 Lon= 39.00

Depth= 12.0 Half duration= 5.9

Centroid time minus hypocenter time: 10.5

Moment Tensor: Expo=26 -0.203 -1.030 1.230 0.464 -0.545 1.140

Mw = 6.8 mb = 0.0 Ms = 6.7 Scalar Moment = 1.77e+26

Fault plane: strike=246 dip=67 slip=-9

Fault plane: strike=339 dip=81 slip=-157

<http://www.koeri.boun.edu.tr/sismo/2/24-ocak-sivrice-elazig-depremi-2/>:



Strong Ground Motion Recordings

The earthquake is recorded by 55 stations of the National Strong Ground Motion Network (<https://depem.afad.gov.tr>). The epicentral distances of these stations vary between 24 and 253 km. The closest station is Sivrice-2308, which sits practically on the fault and has a 23 km epicentral distance. The raw peak ground acceleration at this station 0.298 g, which at the same time is the largest recorded acceleration during this event.

3. PROBABILISTIC SEISMIC HAZARD

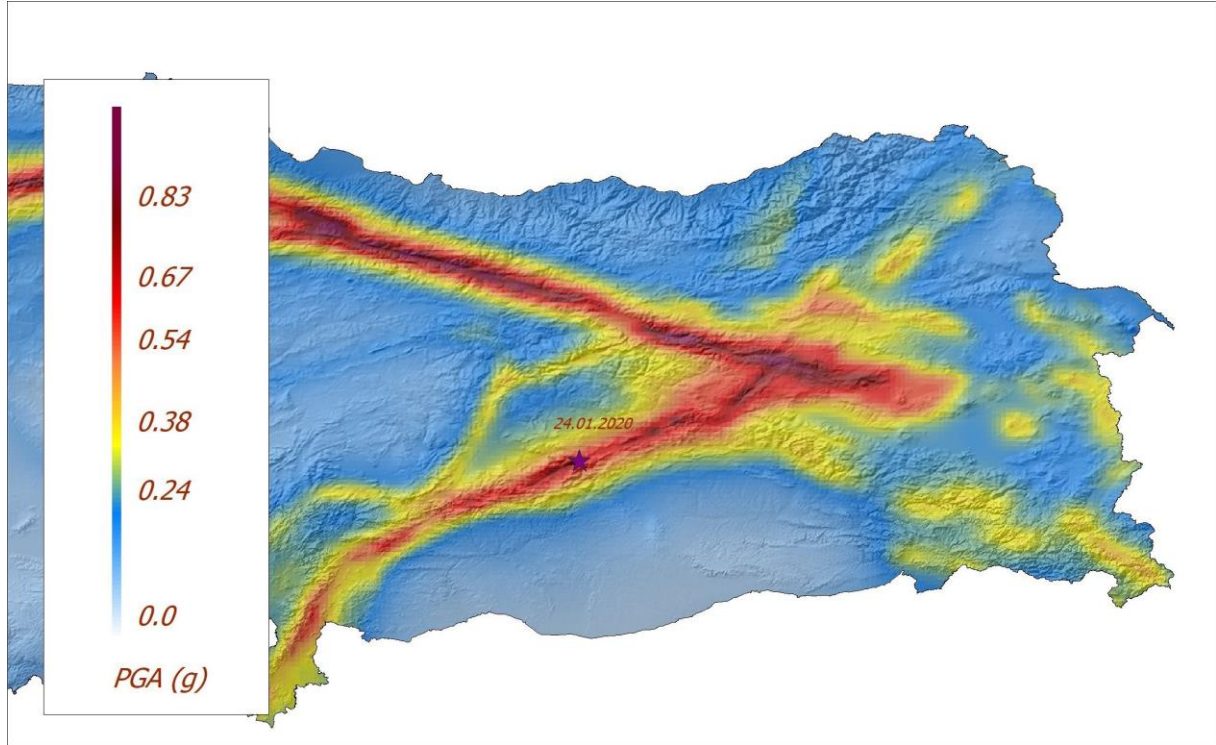


Figure 2. 475 year return period regional PGA distribution according to the recently updated (2018) probabilistic earthquake hazard map of Turkey. The vicinity of the Pütürge segment is associated with PGA values in the order of 0.6 – 0.7 g.

4. DISTRIBUTION OF STRONG GROUND MOTION PARAMETERS

GMPE: Boore and Atkinson, 2008

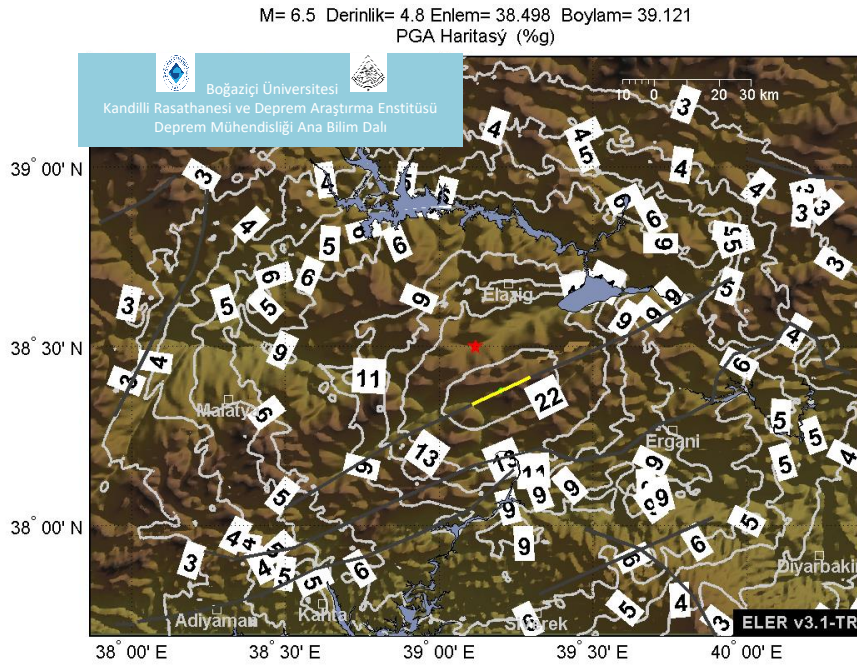


Figure 3. PGA Distribution (%g)

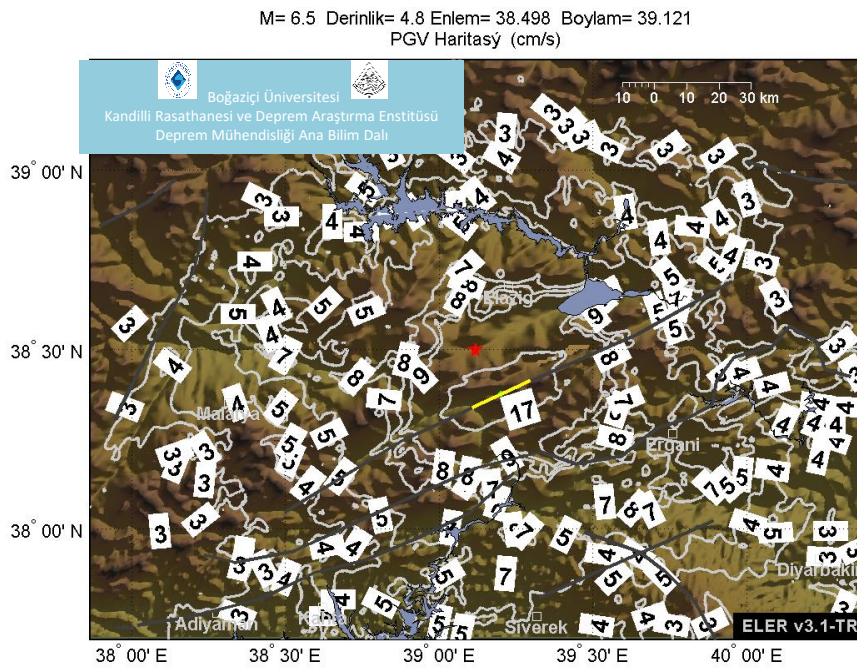


Figure 4.. PGV Distribution (cm/s)

M= 6.5 Derinlik= 4.8 Enlem= 38.498 Boylam= 39.121
PSA02 Haritası (%g)

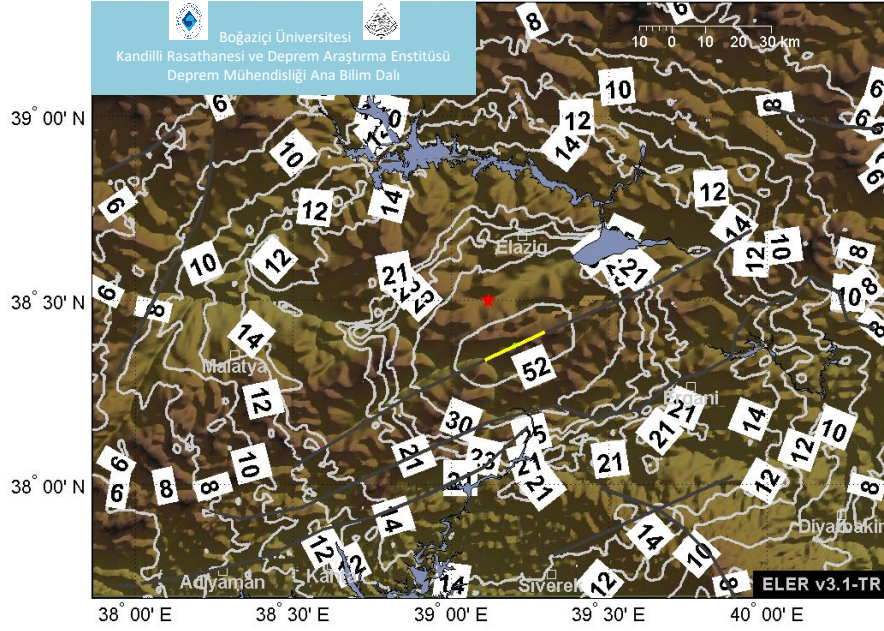


Figure 5. SA (0.2s) (%g)

M= 6.5 Derinlik= 4.8 Enlem= 38.498 Boylam= 39.121
PSA10 Haritası (%g)



Figure 6. SA (1.0s) (%g)

5. INTENSITY BASED BUILDING DAMAGE ESTIMATIONS – 1

Intensity Prediction Equation: Wald et al. 1999

M= 6.5 Derinlik= 4.8 Enlem= 38.498 Boylam= 39.121
INTENS Haritası

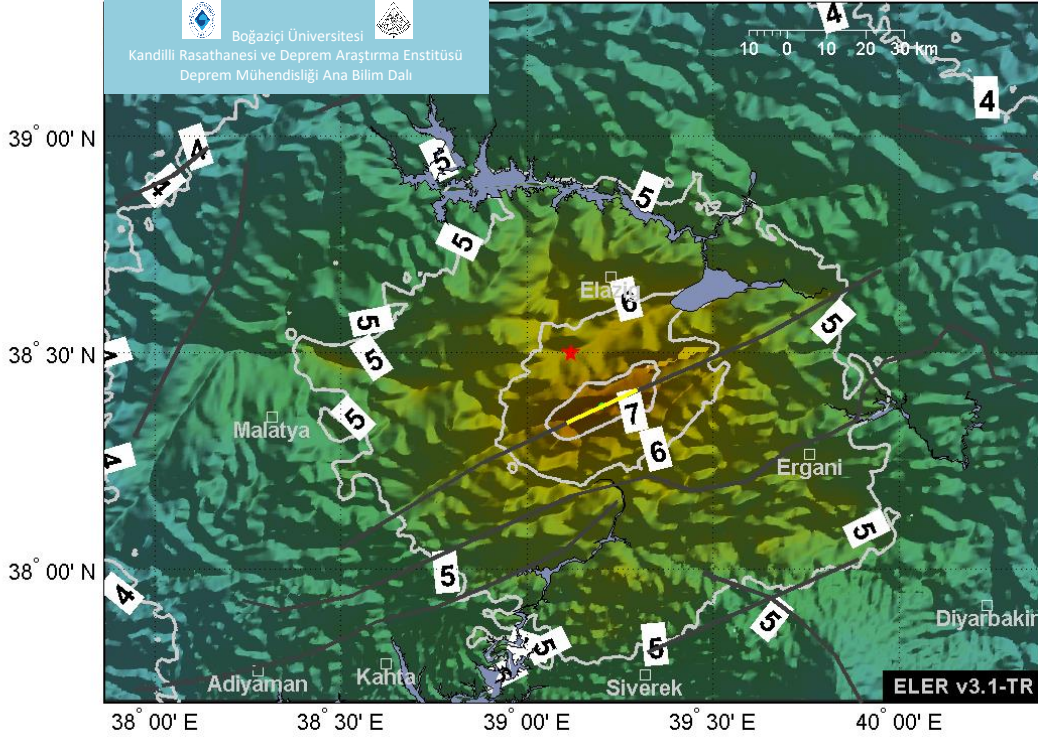


Figure 7. Instrumental intensities (Wald et al. 1999)

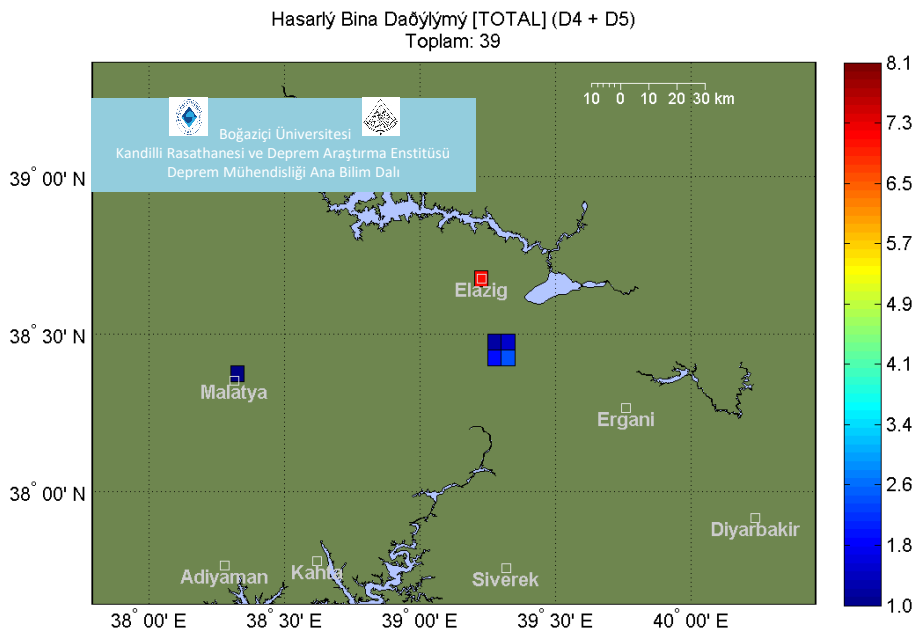


Figure 8. Heavily damaged and collapsed buildings (D4 + D5)

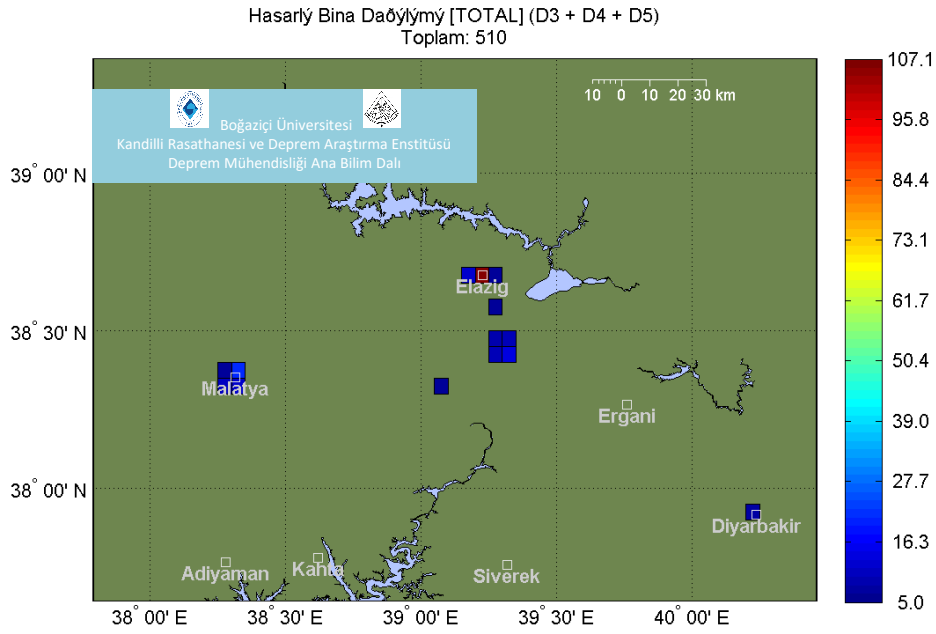


Figure 9. Moderately damaged, heavily damaged and collapsed buildings (D3+D4+D5)

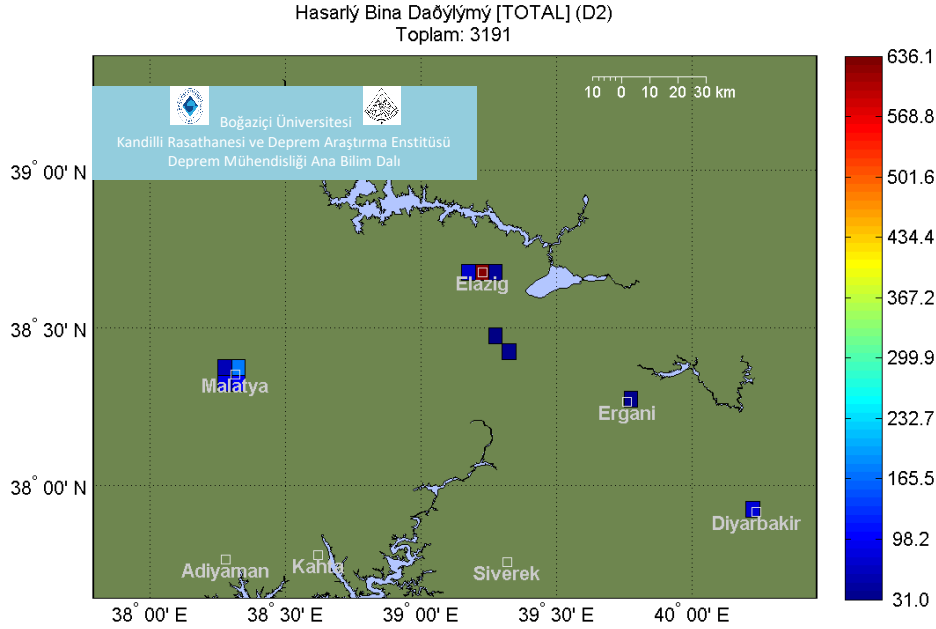


Figure 10. Buildings with slight structural damage (D2)

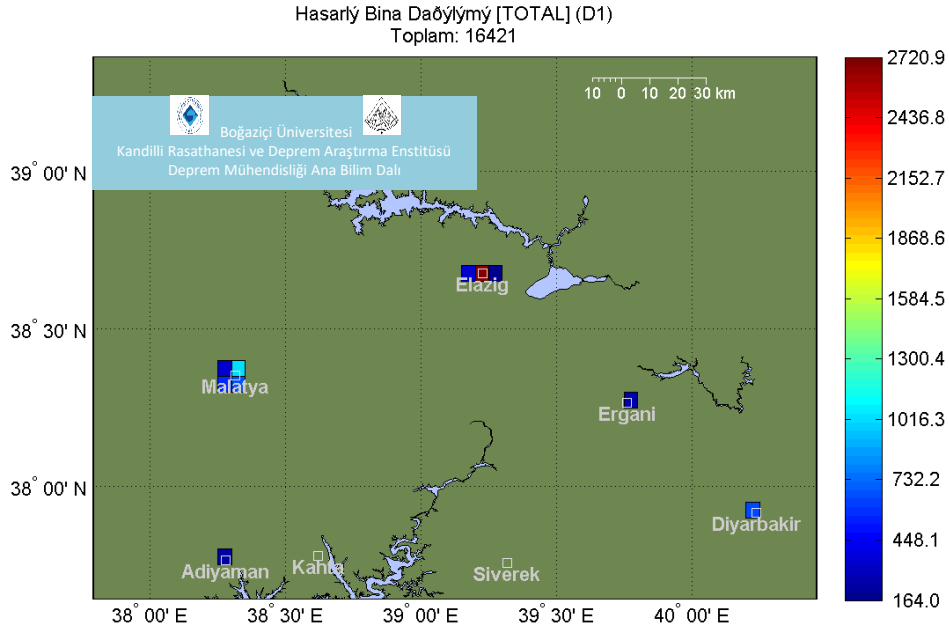


Figure 11. Buildings with slight non-structural damage only (D1)

6. INTENSITY BASED BUILDING DAMAGE ESTIMATIONS -2

Intensity Prediction Equation: Atkinson and Kaka, 2007

M= 6.5 Derinlik= 4.8 Enlem= 38.498 Boylam= 39.121
INTENS Haritası

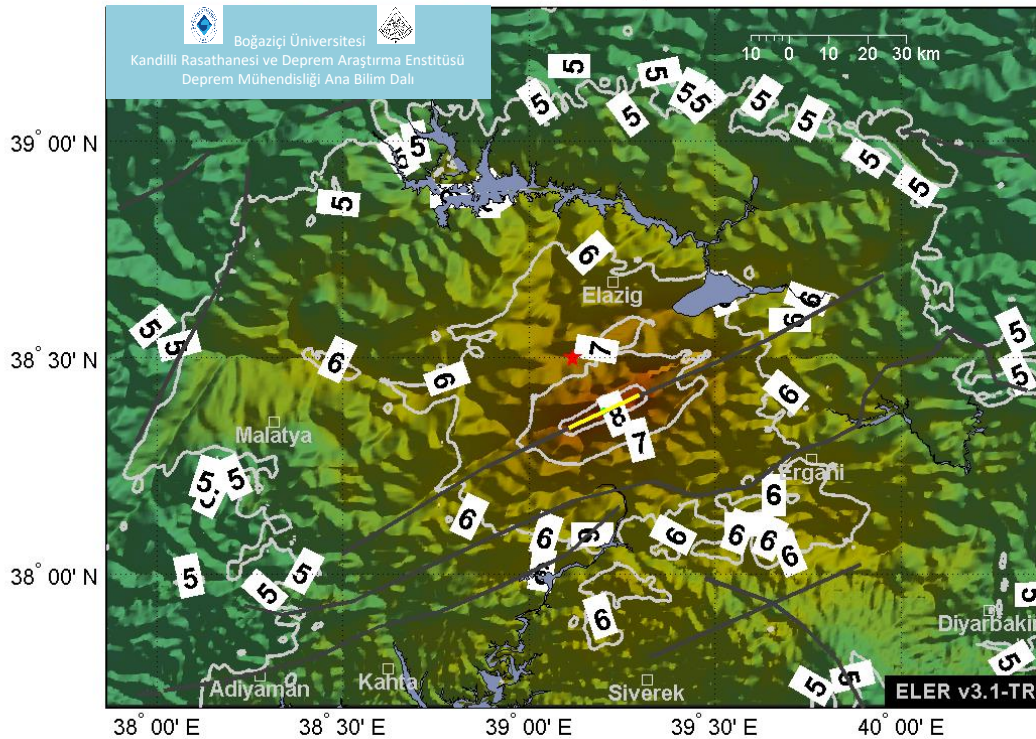


Figure 12. Instrumental intensity distribution (Atkinson&Kaka 2007)

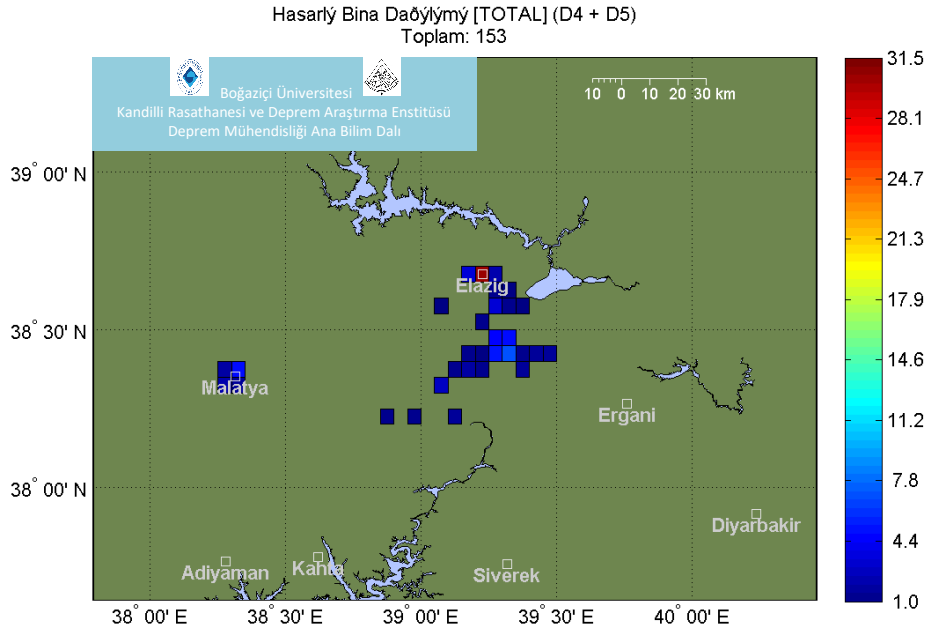


Figure 13. Heavily damaged and collapsed buildings (D4 + D5)

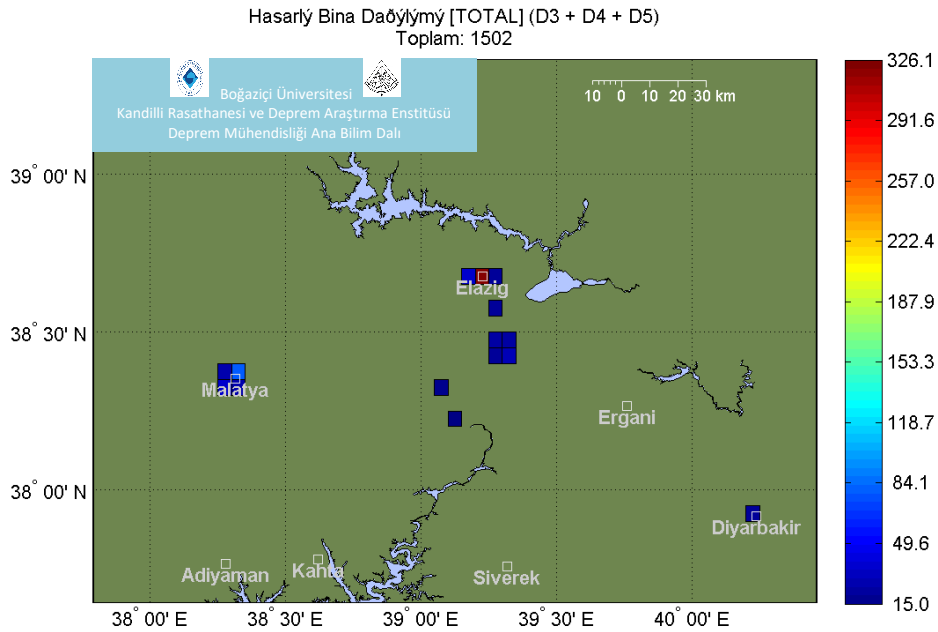


Figure 14. Moderately damaged, heavily damaged and collapsed buildings (D3+D4+D5)

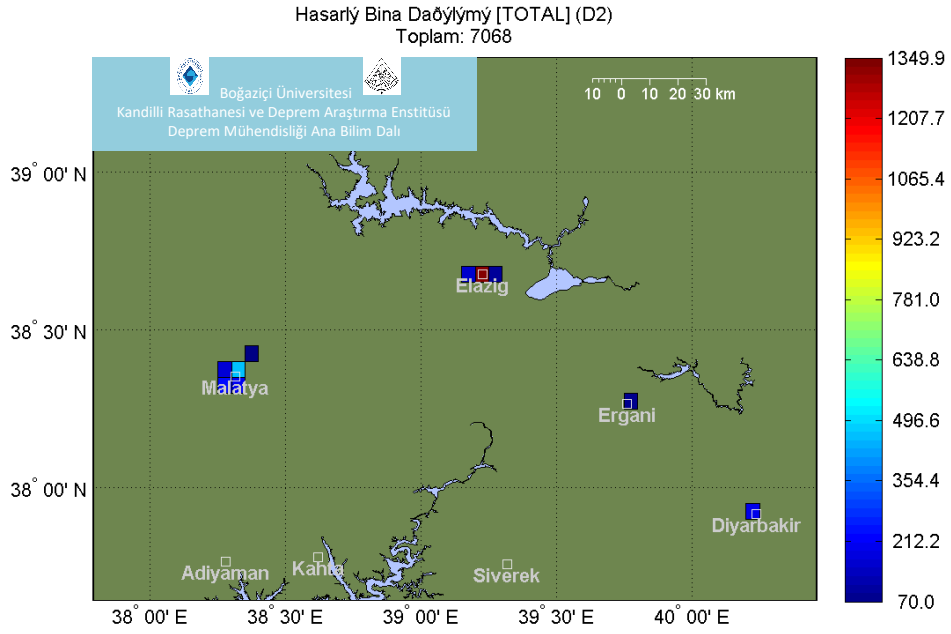


Figure 15. Buildings with slight structural damage (D2)

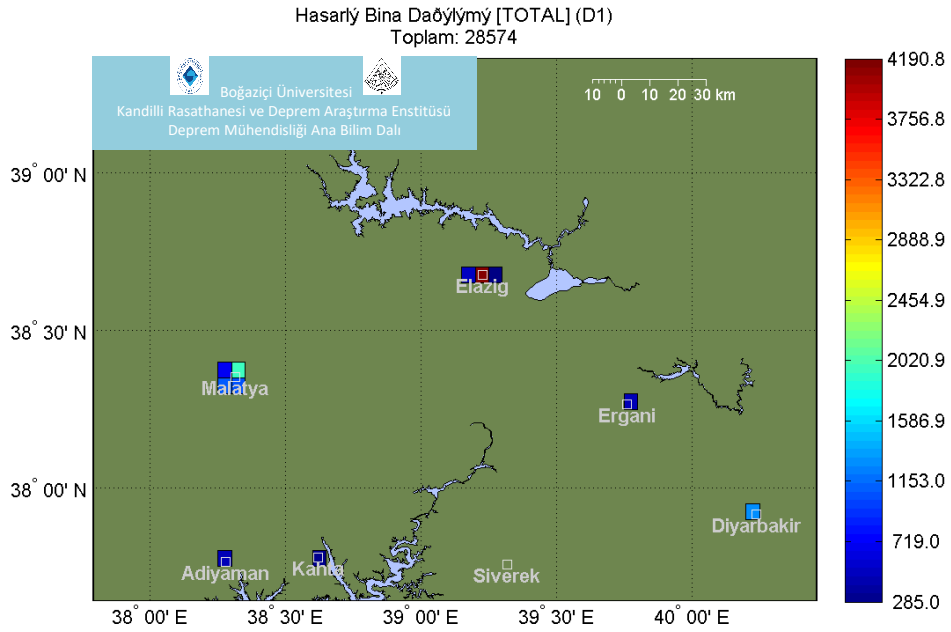


Figure 16. Buildings with slight non-structural damage only (D1)

7. RECORDS OBTAINED AT THE STATIONS OF THE ANTAKYA BASIN STRONG MOTION MONITORING SYSTEM



Figure 17. Epicenter of the Elazığ-Sivrice earthquake and the Antakya Basin Strong Motion Monitoring System

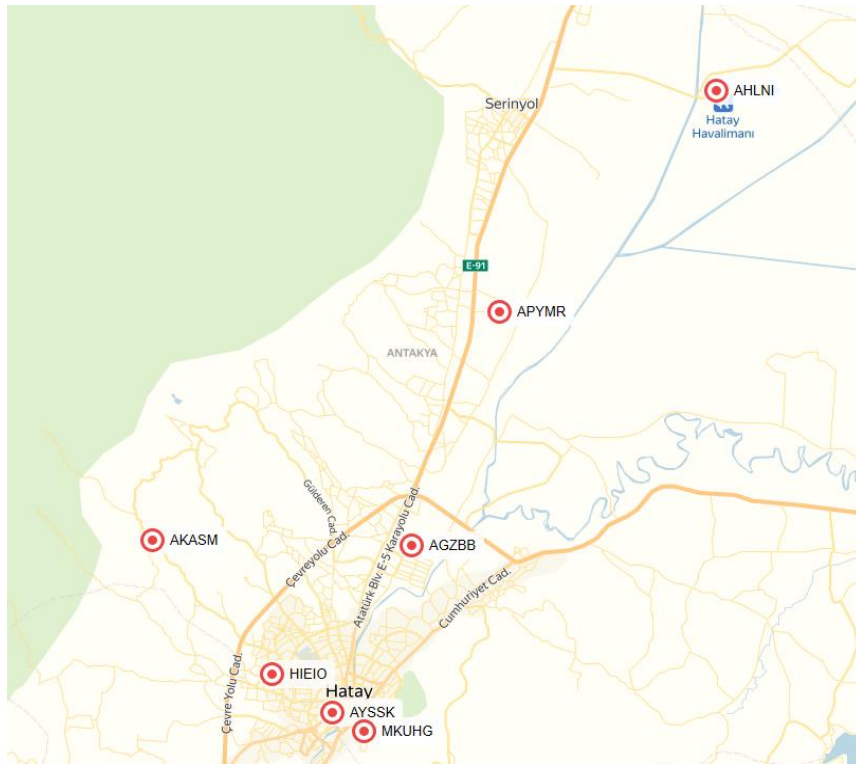


Figure 18. Stations of the Antakya Basin Strong Motion Monitoring System at which Elazığ-Sivrice earthquake is recorded.

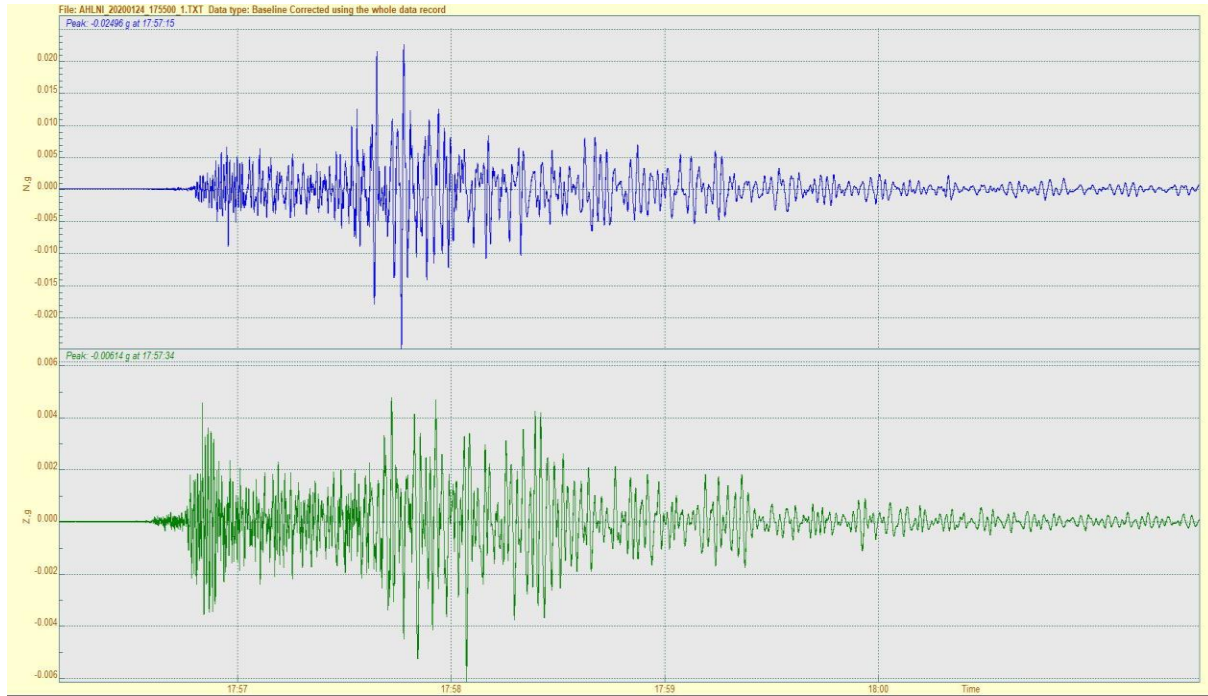


Figure 19. AHLNI station, raw accelerations

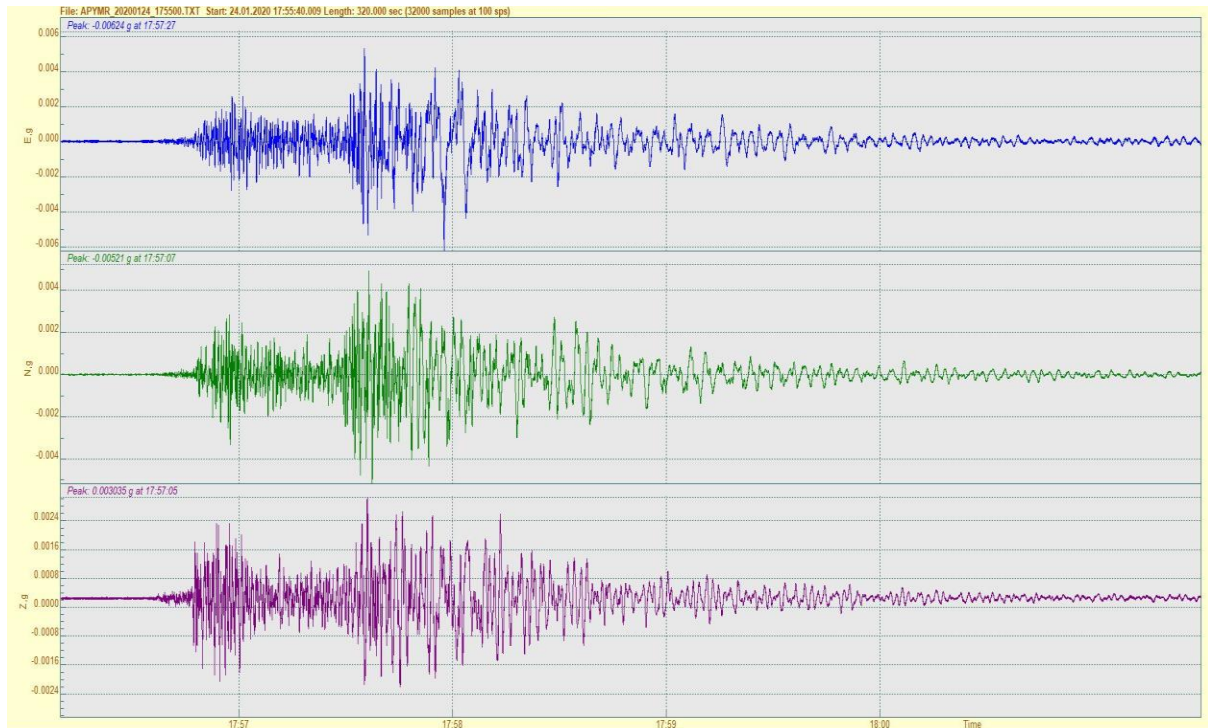


Figure 20. APYMR station, raw accelerations

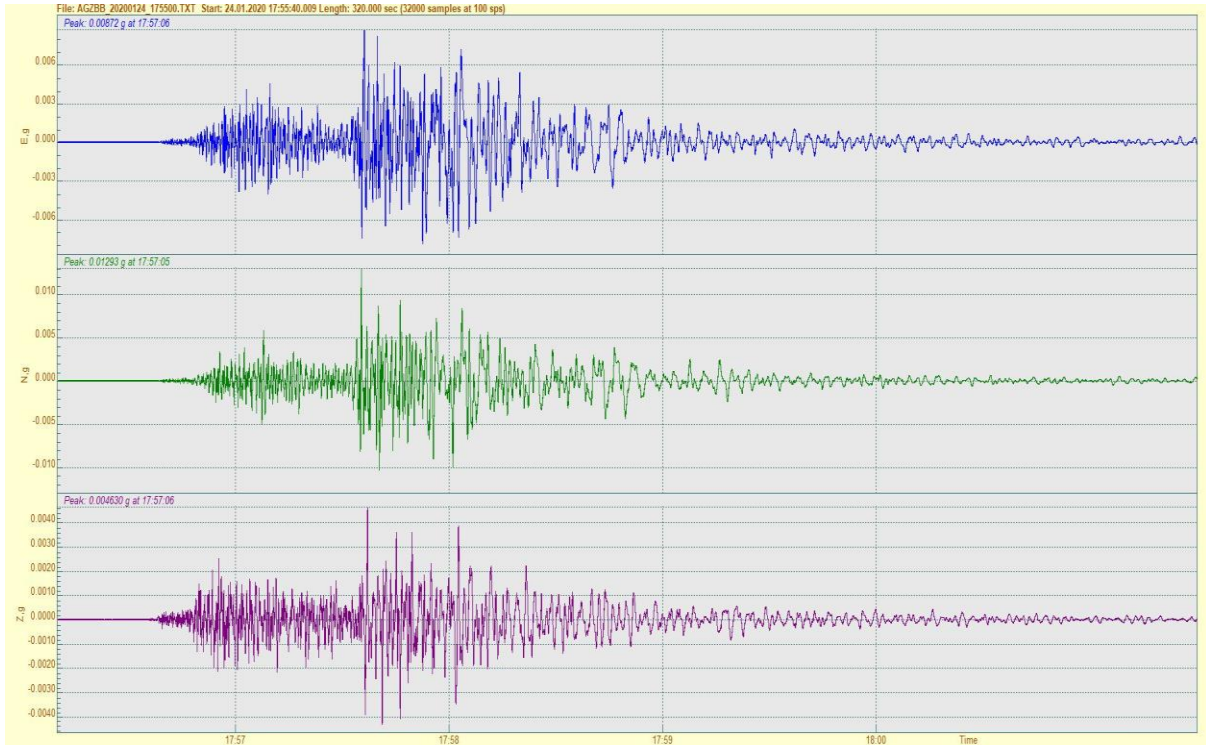


Figure 21. AGZBB station, raw accelerations

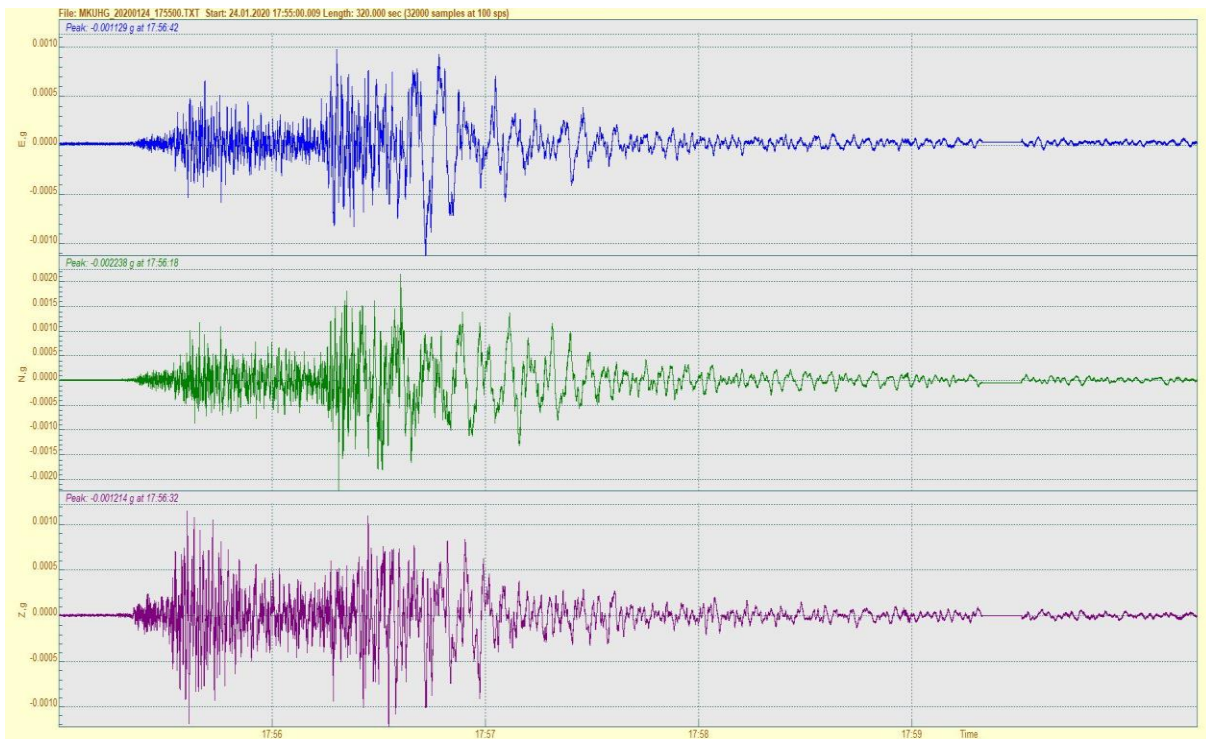


Figure 22. MKUHG station, raw accelerations

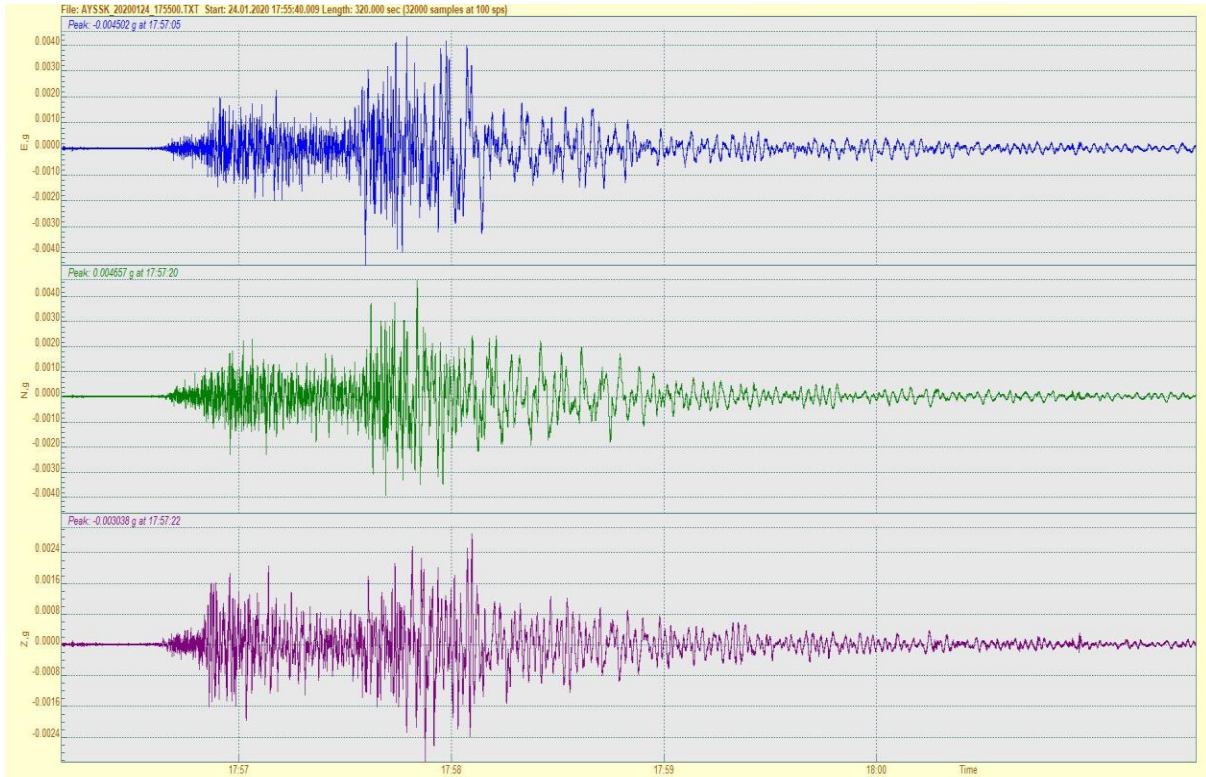


Figure 23. AYSSK station, raw accelerations

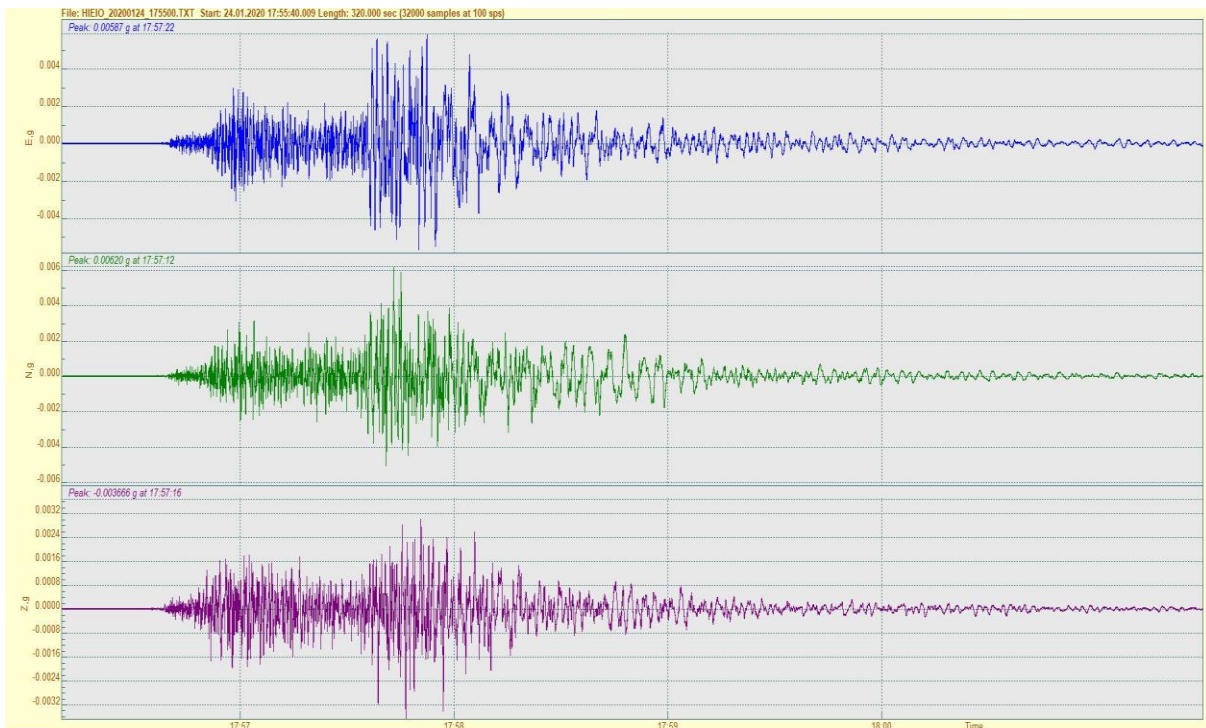


Figure 24. HIEIO station, raw accelerations

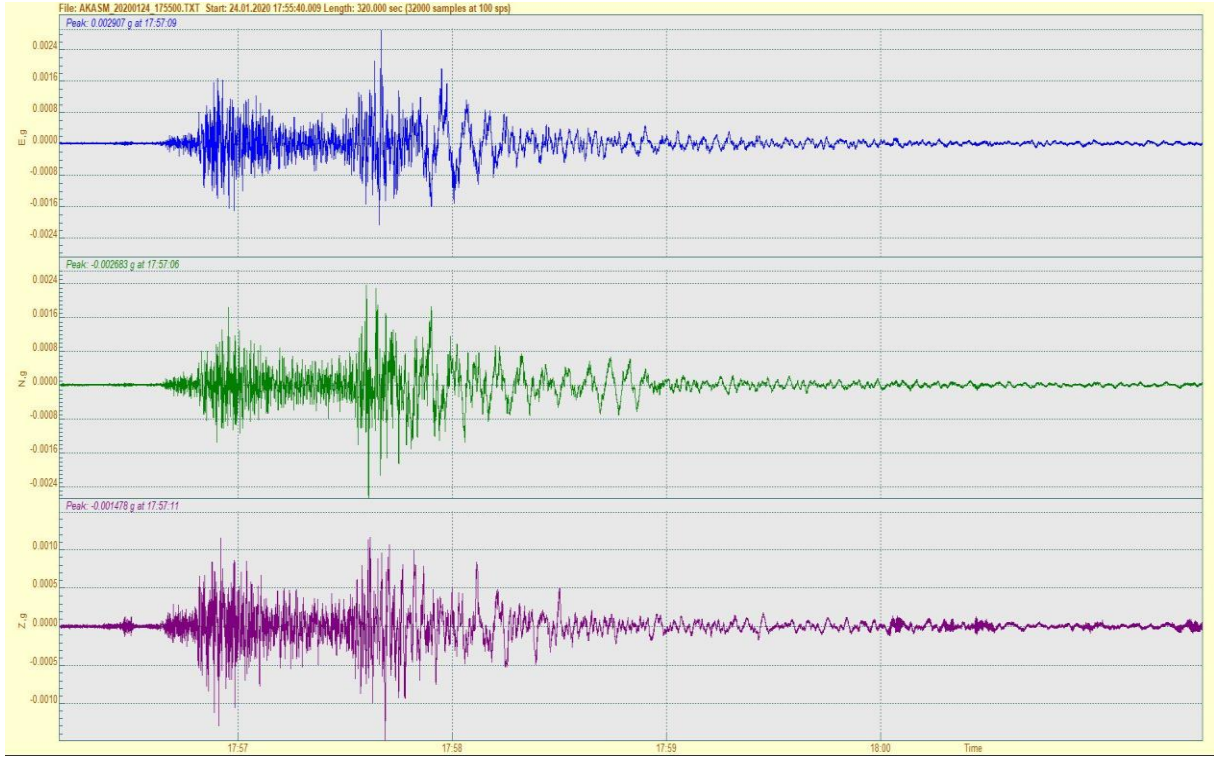


Figure 25. AKASM station, raw accelerations

8. FELT INTENSITIES REPORTED OVER EARTHQUAKE INFORMATION SYSTEMS



Figure 26. Feedback by the users of the Earthquake Information System 3.0 (324 reports). First report was received at 21:17 local time, approximately 20 min after the earthquake.

Felt reports received for M6.8 earthquake
 in EASTERN TURKEY
 on 2020-01-24 17:55:14 UTC



832 feltreports on this map

500 km

Updated on 25/01/2020 at 11:48 UTC

★ Epicentral location

Reported as: Not felt Felt Largely felt Damaging

Figure 27. Reported intensities over the EMSC LastQuake Application

9. HISTORICAL SEISMICITY OF THE REGION

Roads and sites in the **Euphrates** valley east of Malatya

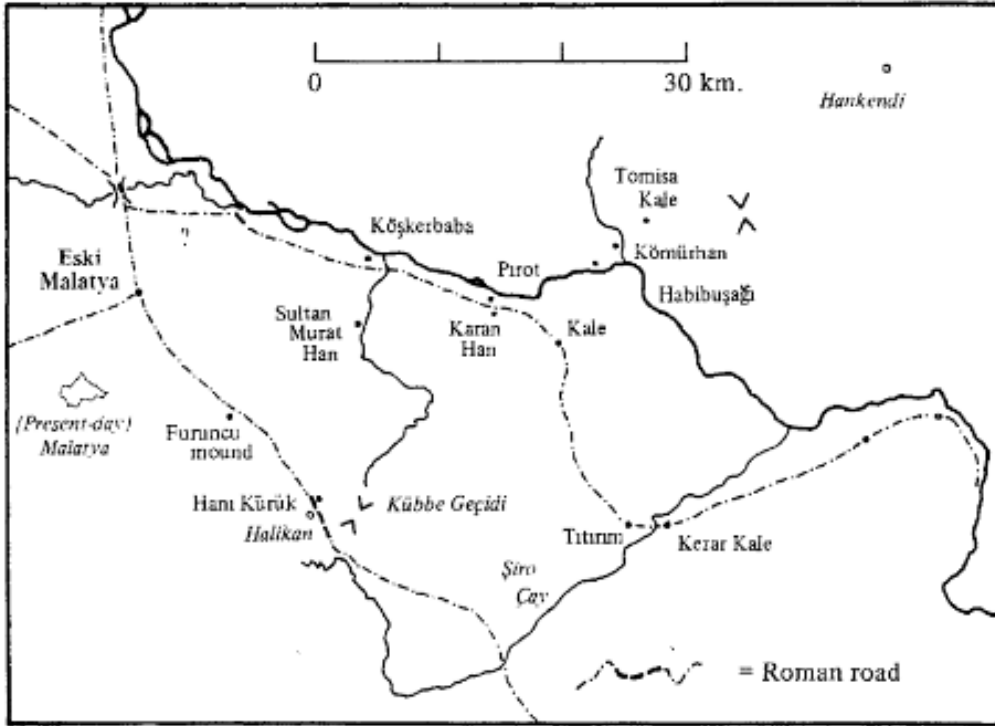


Figure 28. Information available about the oldest earthquake on the East Anatolian Fault Zone is the 817 A.D. event that damaged the antic city of Claudias (Ambraseys, 2009). The event is reported to cause life loss and important environmental effects. The city of Claudias is currently named as the antic city of Kerarkale (Ref: Eastern Turkey: An Architectural & Archaeological Survey, Volume III, p. 41)

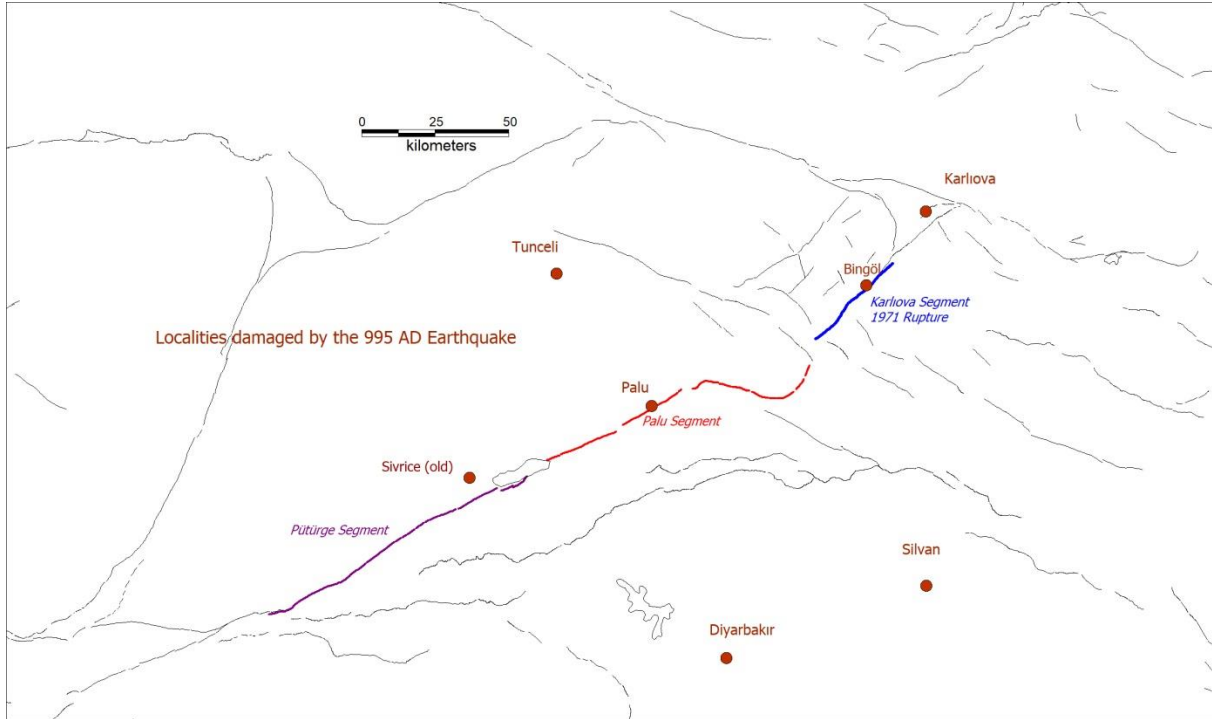


Figure 29. Localities damaged in the 995 A.D. earthquake (Ref: Guidoboni et al., 1994 and Ambraseys, 2009).

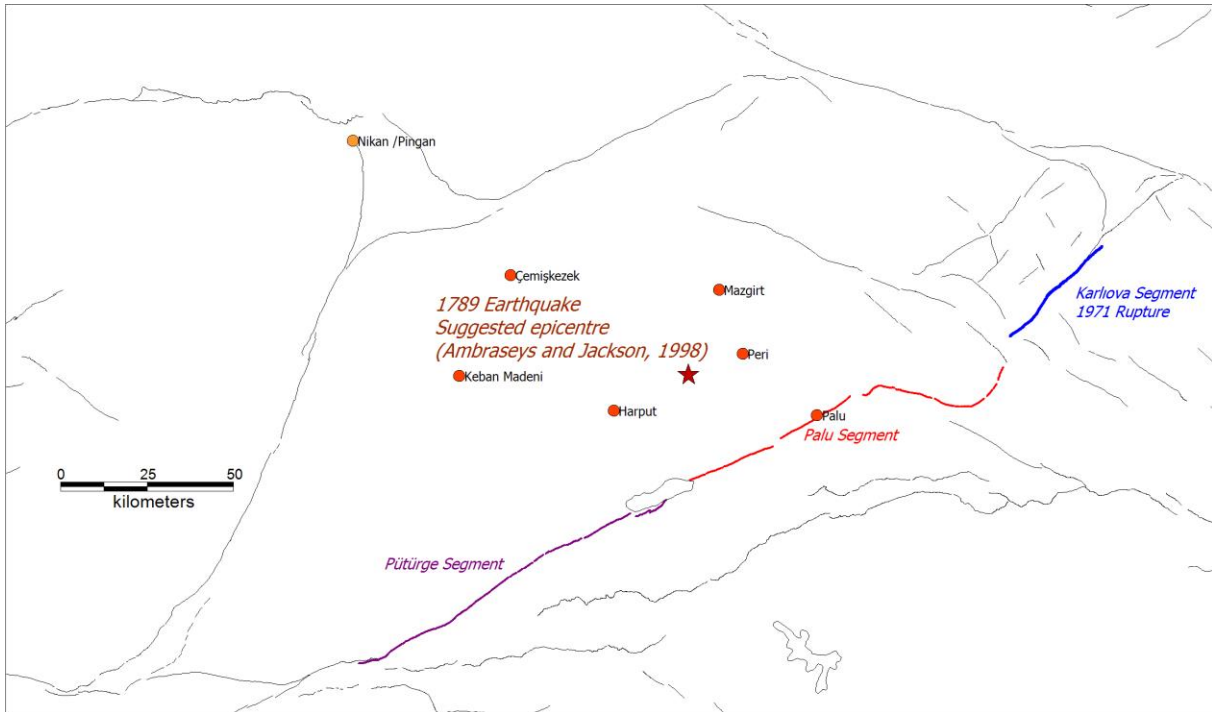


Figure 30. Localities damaged in the 28 May 1789 Elazığ earthquake (Ref: Ambraseys, 2009)

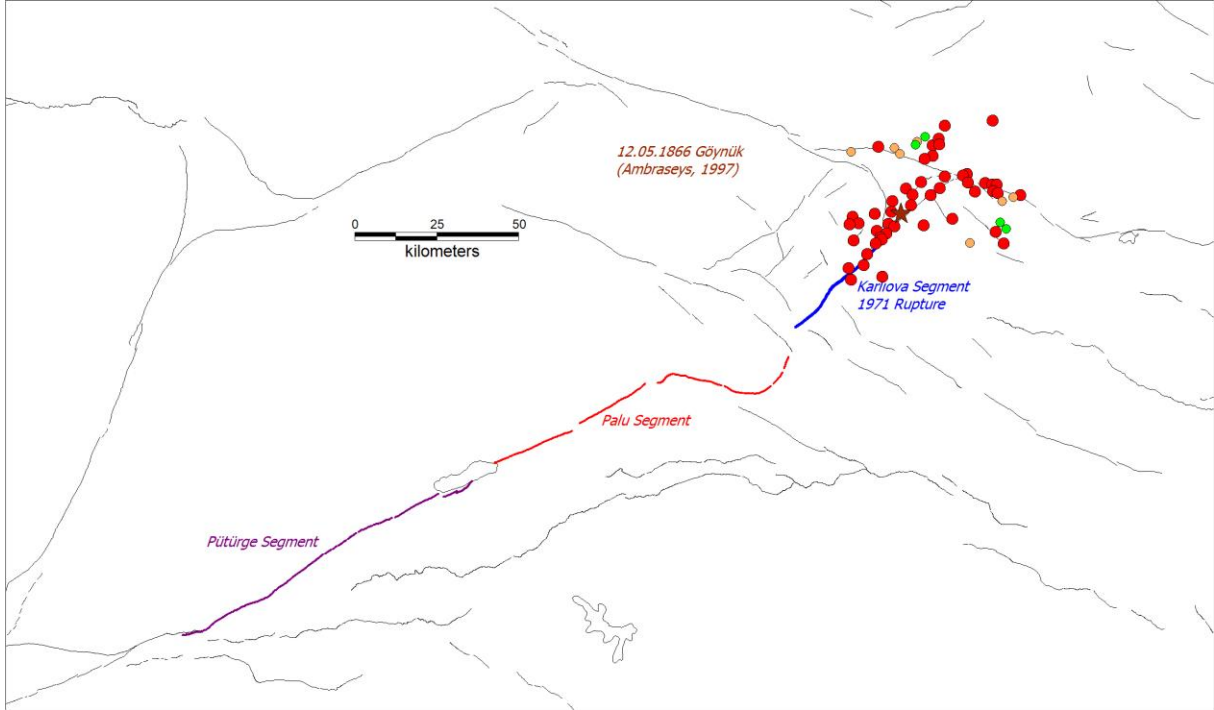


Figure 31. Localities damaged in the 12 May 1866 Göynük earthquake (Ref: Ambraseys, 1997)

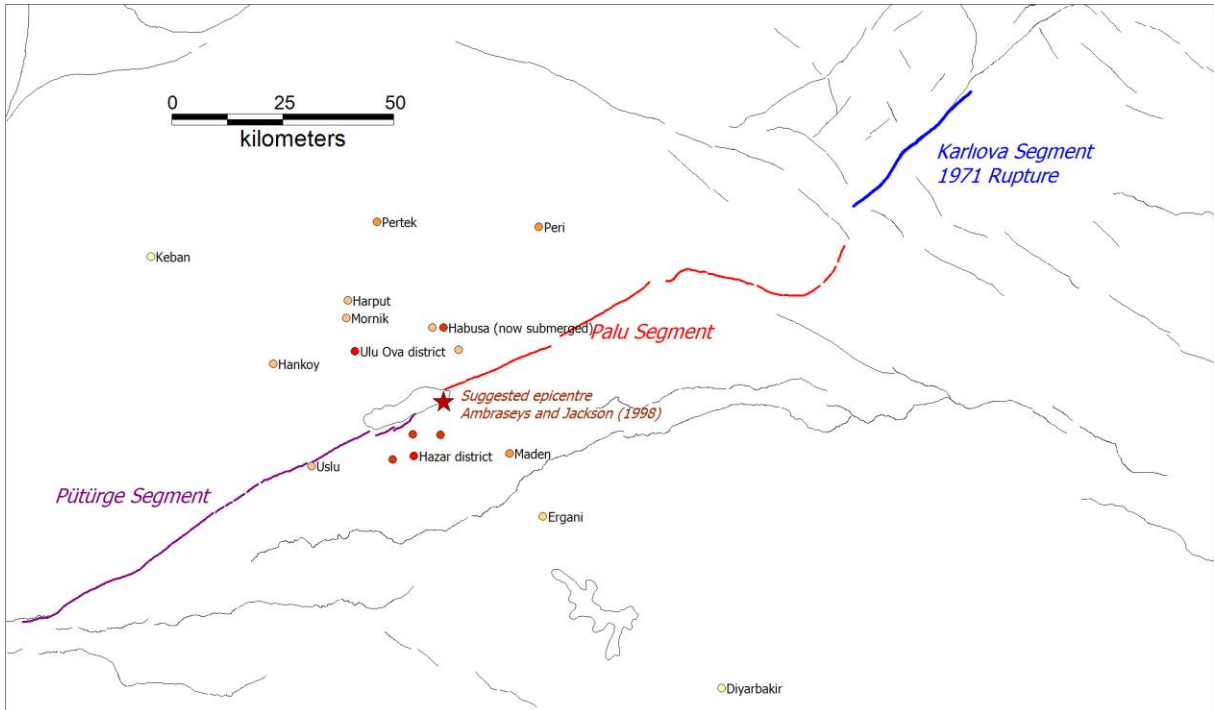


Figure 32. Localities damaged in the 3 May 1874 Gölcük earthquake (Ref: Ambraseys, 2009). Ambraseys and Jackson (1998) estimate the magnitude as Ms 7.1.

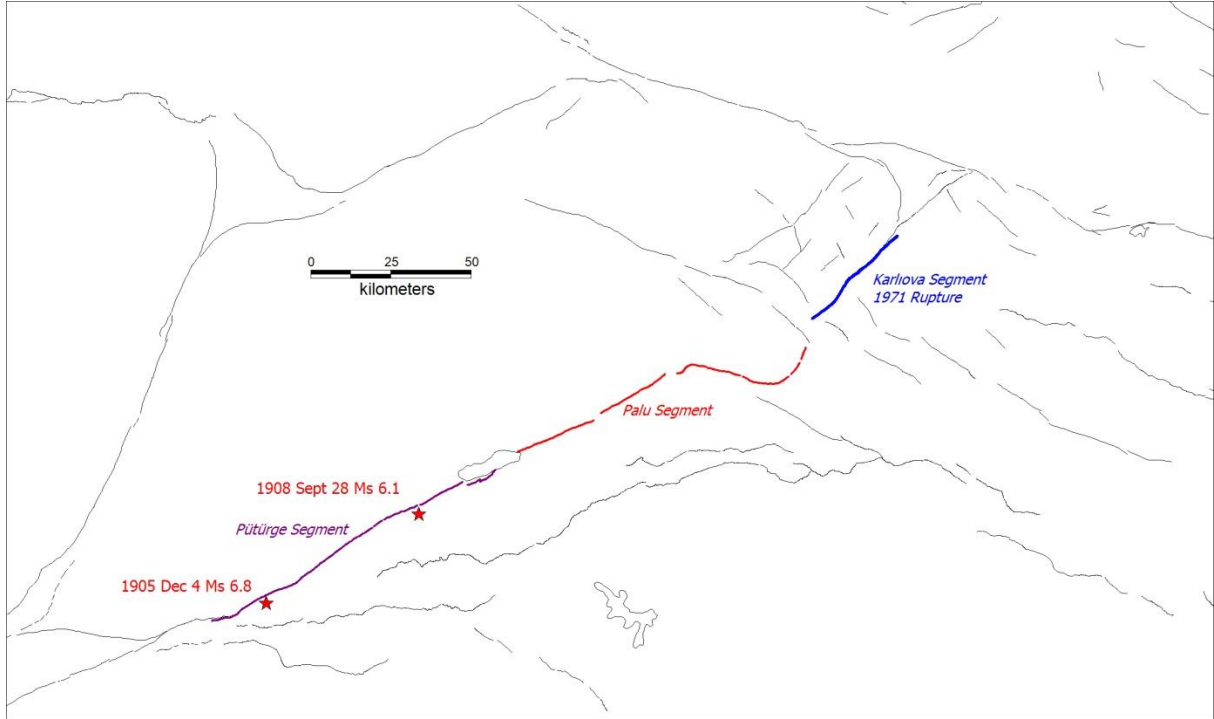


Figure 33. Two earthquakes of the region that happened in the early 20th century are the 4 December 1905 Ms 6.8 ve 28 September 1908 Ms 6.1 earthquakes (Ambraseys and Finkel, 1987). These two events can be associated with the Pütürge segment.