March 08, 2010 BASYURT-KARAKOCAN (ELAZIG) EARTHQUAKE
Kandilli Observatory and Earthquake Research Institute-Bogazici University-Istanbul, Turkey

1. Introduction

An earthquake of magnitude Mw=6.0 occurred on March 8, 2010 at 04:32 local time, in Elazig province, Basyurt-Karakocan region of Turkey. Immediately after the earthquake a team from the Kandilli Observatory and Earthquake Research Institute went the the earthquake affected area a prepared a comprehensive report, which can be downloaded at:
http://www.koeri.boun.edu.tr//depremmuh/eqspecials/elazig/8Mart2010_Elazig_earthquake_eng.pdf

Figure 1 indicates the location of the earthquake on a map that shows the epicenters of all events with Mw>=6 in Turkey since 1900. Figure 2 illustrates the epicentral location on the left lateral strike slip East Anatolian Fault. The fault mechanism solution of the earthquake also indicates left lateral strike slip mechanism. About three hundred villages have been affected, 42 people died, and 137 people injured.

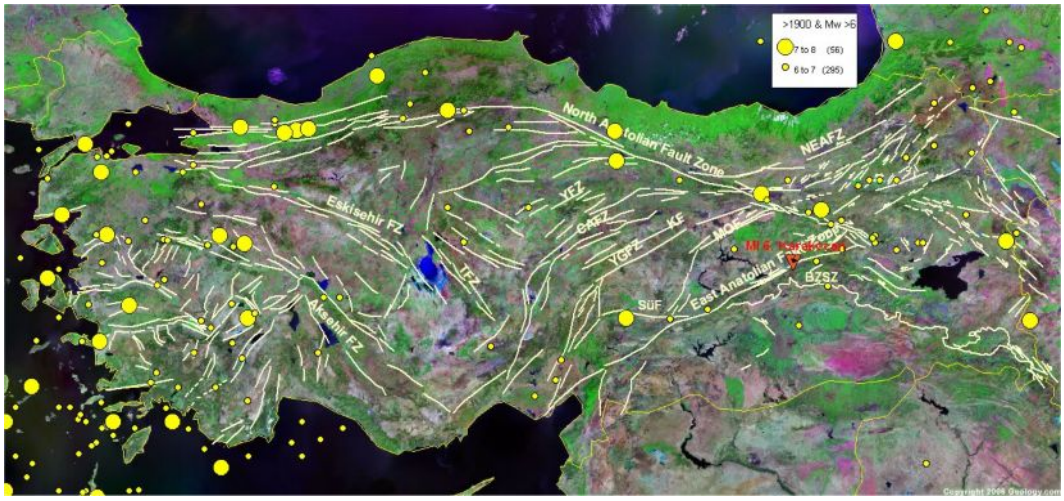

Figure 1. Figure 1 indicates the location of the earthquake on a map that shows the epicenters of all events with Mw>=6 in Turkey since 1900

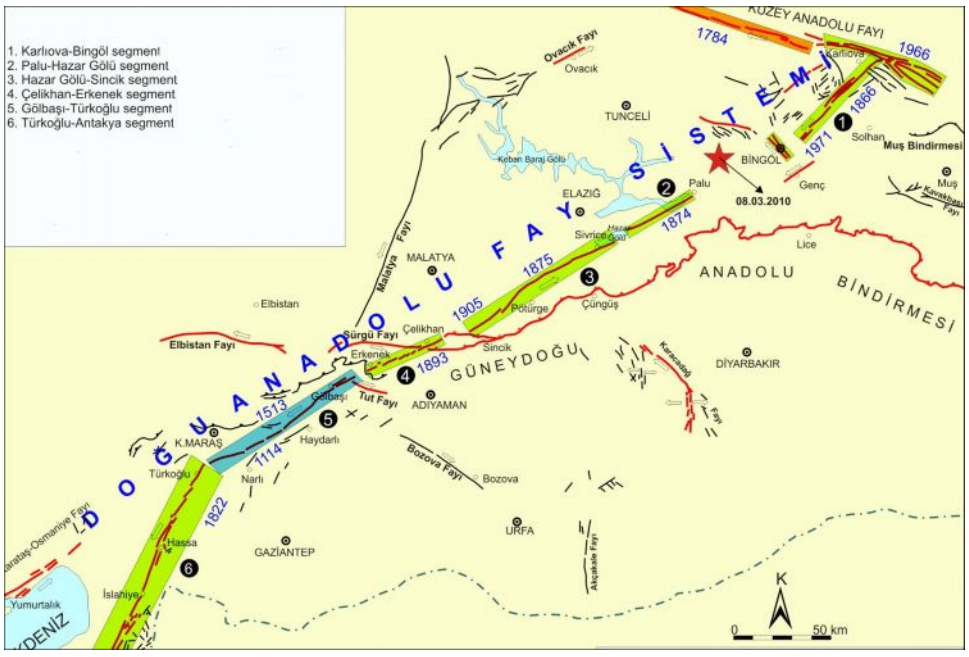

Figure 2. The Elazig Earthquake (red star) took place on the East Anatolian Fault, where the previous fault ruptures are indicated (After, General Directorate Mineral Investigation and Research)

2. Seismo-tectonic Characteristics of the Region

Başyurt-Kovancılar-Gökdere region where the main shock has occurred is located within the East-Anatolian Fault Zone (EAFZ). In Turkish Earthquake Zoning Map, the region is placed in partly Zone-1 and Zone-2, and it is within the significant deformation area. The region is positioned between North-Anatolian Fault Zone (NAFZ) and EAFZ, and shows high seismicity due to the active fault systems and multi-rupture characteristics.
The 1789 Palu (Io=VIII; 51.000 casualties, faulting=20 km.), 1866 Southern Hazar Lake -Elazığ (Io=VIII), 1874 Harput-Elazığ-Diyarbakır (Io=VIII) and 1875 Karlıova-Bingöl-Palu-Elazığ (Io=VIII; M=6.1) earthquakes are important historical earthquakes in the region (Soysal et al., 1981). In instrumental period, 1949 Karliova (Io=IX; Ms=6.7), 1971 Bingol (Io=VIII; Ms=6.8), 1975 Lice (Io=VIII; Ms=6.6), 2003 Pulumur (Io=VII; Ms=6.2), 2003 Bingol (Io=VIII; Ms=6.4) and 2004-2007 Sivrice earthquakes (Ml=5.5-5.9) affected the region.

3. Earthquake Source Parameters

The fault mechanism solutions, done by Bogazici University-Kandilli Observatory and Earthquake Research Institute (KOERI) after the earthquake, showed that the earthquake has a left-lateral faulting mechanism (Figure 3). The source parameters of the earthquake are given in table below;

Table 1: Earthquake source parameters

Source Parameter of Başyurt-Karakoçan (Elazığ-Eastern Turkey) Earthquake										
Date d/m/y	O.Time h/m/s U.T.C	Lat. deg.	Lon. deg.	Dep. km.	Seismic Moment Mo dyn.cm	Moment Mag. Mw	Fault Plane Parameters NP1 strike/dip/rake	P axis Az./Plg.	T axis Az./Plg.	Location ELAZIĞ
08.03.2010	02:32:31	38.798	40.156	4	1.30E+25	6.0	33/74/-30	4.9/46.0	264.6/9.8	Başyurt-Karakoçan (ELAZIĞ)

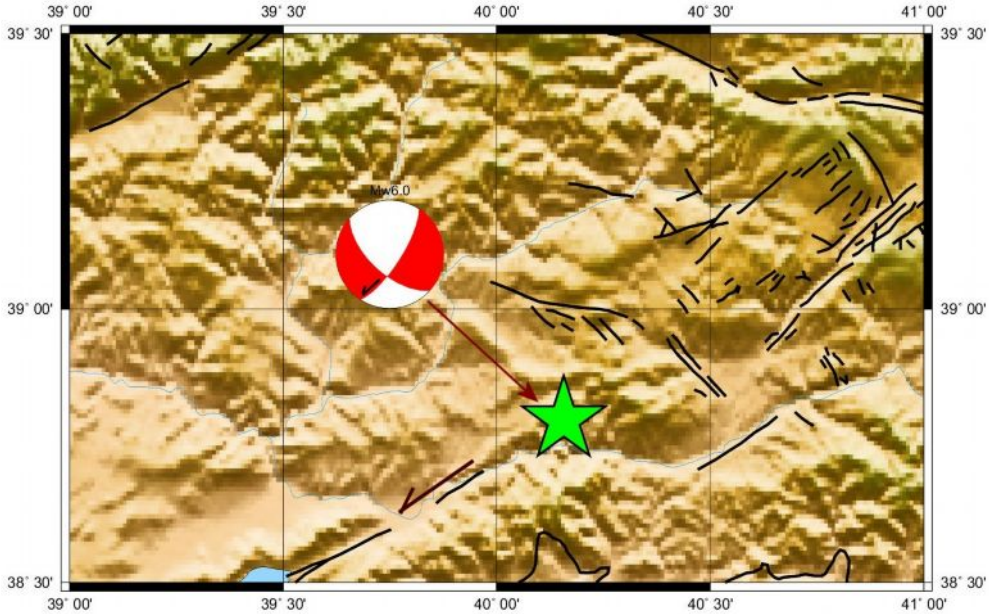

Figure 3. Fault mechanism

4. Earthquake Shaking and Damage Estimations

ELER (Earthquake Loss Estimation Routine) which has been developed by the Earthquake Engineering Department of KOERI, Bogazici University has been applied for real-time earthquake shaking estimations immediately after the earthquake. The shake map provided in Figure 4 provides a very good match with field observations.

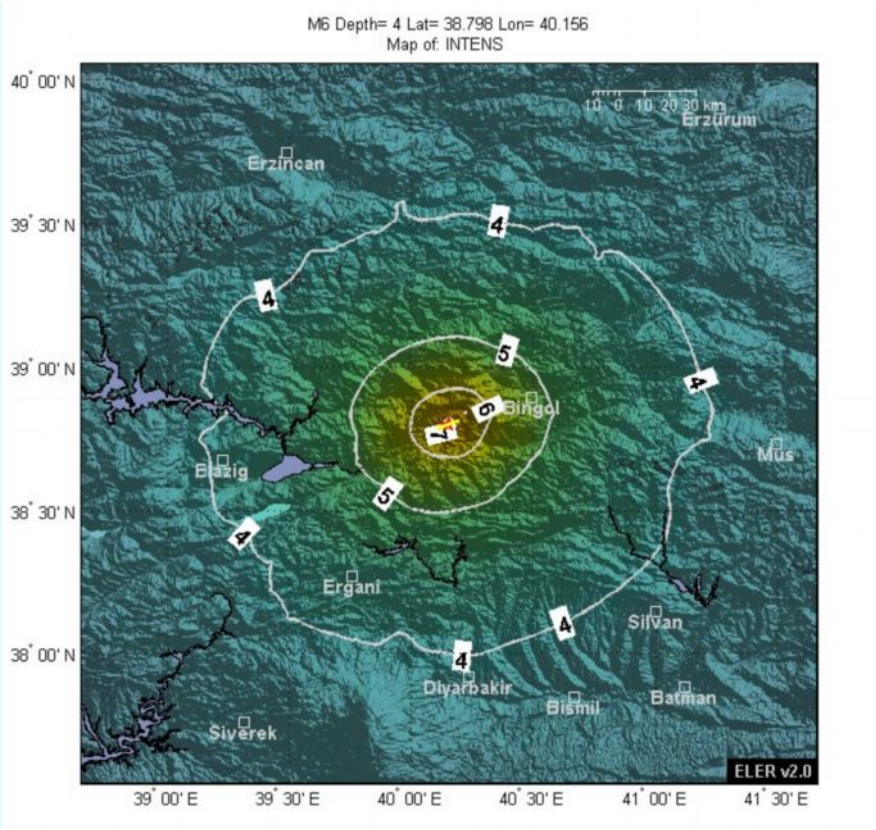

Figure 4. Earthquake Shaking Map (European Macroseismic Scale'1998 Intensity Units)

5. Strong Motion Records

9 stations belonging to Turkey National Strong Motion Network has recorded the main shock. The acceleration records have been distributed through Turkey National Strong Motion Network's web-site (http://daphne.deprem.gov.tr). The PGA values in these stations and the stations' epicentral distances are given in Table-5, and the acceleration waveforms are shown on the map in Figure-5.

Table 2: PGA and distance information of Strong Ground Motion Stations

Station Codes	PGA (cm/s^2)			Distance (km)
	NS	EW	UD	
2301	5.56	4.77	3.85	73.70
1201	55.31	34.27	25.50	43.30
2303	62.00	66.50	30.00	12.20
1206	11.59	17.84	8.95	102.40
201	2.50	2.24	1.64	190.90
4701	2.54	2.46	1.68	172.00
7201	7.62	5.44	2.52	140.10
2101	3.44	5.10	2.59	94.90

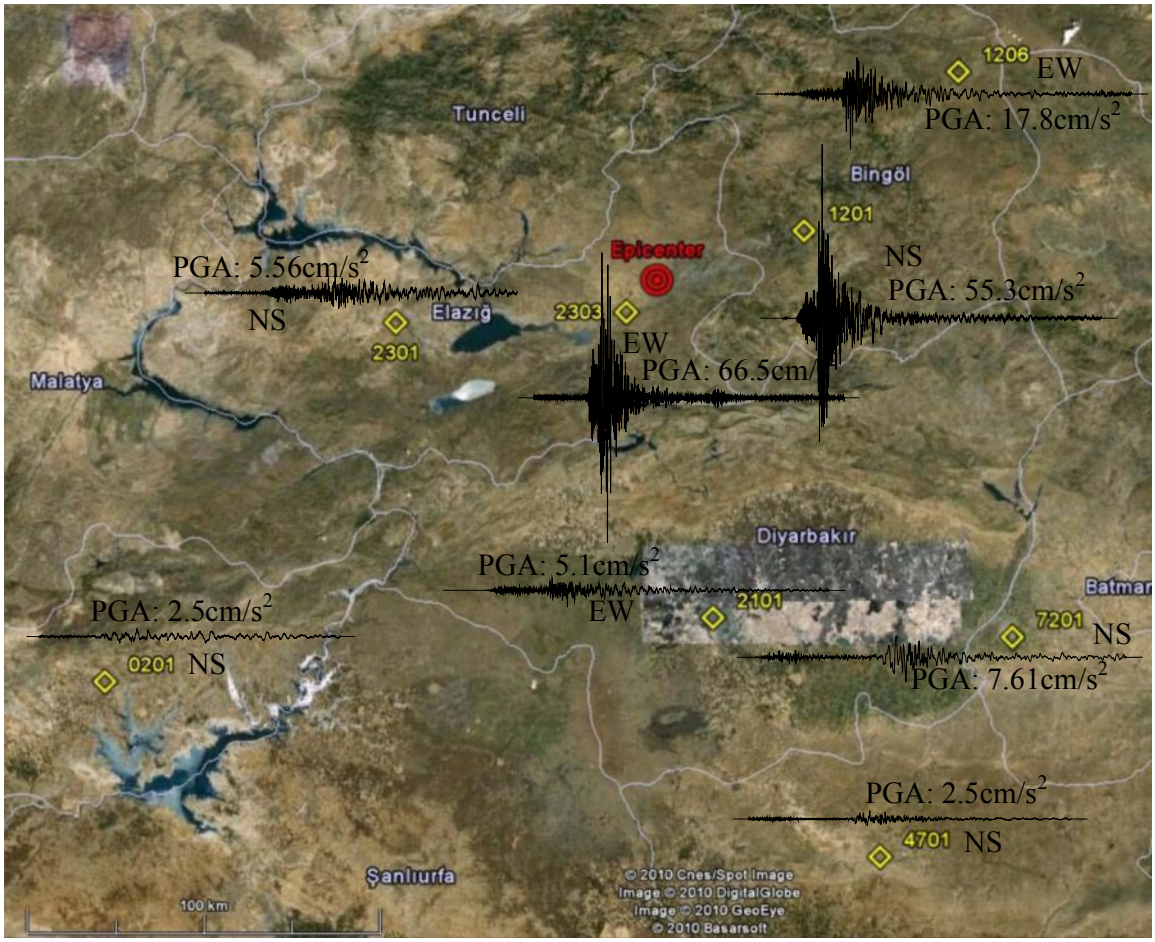

Figure 5. Location of National Strong Motion Stations and acceleration-time waveforms

6. Damage to Buildings

Official number of houses with light, moderate and heavy damage is respectively: 3854, 1561 and 3007. The earthquake affected region consists of small villages with R/C frame and unreinforced brick, concrete block and adobe masonry. Most of the URM buildings are old and rather unmaintained. Following figures illustrate the damage observed.

Figure 6 : Outside view of two storey soil brick house in Kökan-Bayramyazı (Almost no damage)

Figure 7. Two storey soil brick house in Incedal village-front view (Light Damage)

Figure 8. Two storey adobe house, front view, Okcular (Total damage)

Figure 9: One story typical school building, Okcular village

Figure 10. Two storey light stone house, with a stall as ground floor, Okcular (Partial Collapse)

Figure 11. Outside view of two storeys mixed structural system, Okcular village

Figure 1: Damage to Brick URM Building, Incedal village

Figure 13: Prefabricated panel houses built after 1971 Bingol earthquake, still in use, Incedal village

Figure 14: RC house, without any damage in beam-column joints, Okcular village

Figure 15: RC house, built by government, after 2003 Bingol earthquake, Tabanözü village

Main reasons of dense damage within Başyurt-Kovancılar-Gökdere region are as following;

- Improper material and construction techniques have been used.
- Villages are located on steep and risky locations for landslides or on flat but saturated soil conditions.

The most common damage type is partial collapse of load bearing walls due to “out of plane” behavior. Even if load bearing walls could stand after earthquake without total or partial collapse, wide cracks prevents usability of the buildings.