October 16th, 2024 Akuşağı-Kale, Malatya Earthquake (M_w5.9) Earthquake Information Report

18.10.2024

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Content

01 | General Information

- An earthquake of magnitude Mw5,9 occurred on October 16th, 2024, at 07:46 (UTC) in Akuşağı-Kale (Malatya). The earthquake parameters reported by AFAD are given in Table 1. The Global Centroid Moment Tensor (GCMT) solution is provided in EMSC-CSEM database. The earthquake was felt in the Elazığ and Malatya region with a macro-seismic intensity of MMI up to VIII.

- The relation between measured peak ground acceleration (PGA) and source-to-site distance (Joyner-Boore distance) recorded by AFAD strong-motion stations are shown in Figure 1.

Table 1. *Earthquake parameters*

Magnitude	Mw 5,9
Location	Akuşağı-Kale (Malatya)
Date time	16/10/2024 07:46:32
Epicenter	38,36583 N-38,80861 E
Depth	10,48 km

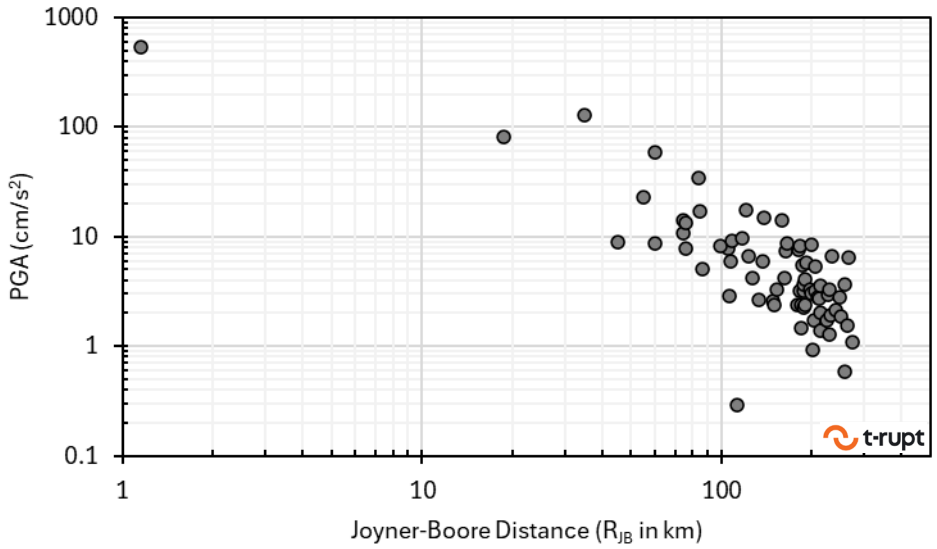


Figure 1. *Geometric mean PGA (cm/s²) vs R_{JB} (km) relation of the Mw 5.9 Akuşağı-Kale earthquake (Data source: AFAD)*

02| Main seismic features of the event

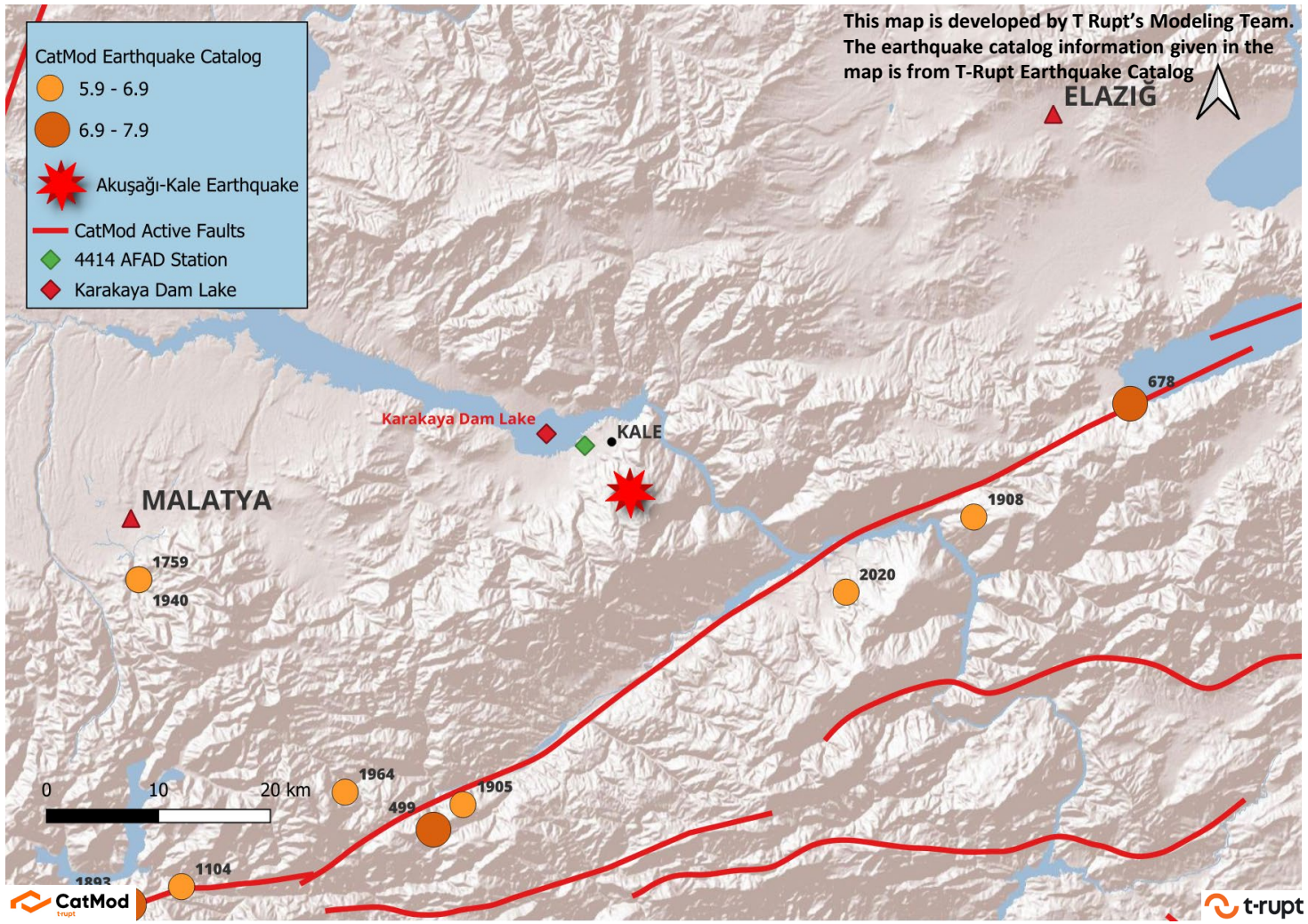


Figure 2. *Large magnitude historical and instrumental earthquakes (T-Rupt Earthquake Catalog) in the vicinity of the Akuşağı-Kale earthquake. The red star shows the epicenter of the event as determined by AFAD. The occurrence years of the earthquakes are given in the upper right corner of each event.*

- On October 16th, 2024, a shallow crustal earthquake of magnitude Mw 5,9 occurred in the area between East Anatolian Fault Zone (EAFZ) and Karakaya Dam Lake. The red star in Figure 2 designates the epicentral location of the earthquake. Taking into account the 14 km distance from the EAFZ, this event is believed to occur on one of the secondary faults of the EAF.

- No significant damage has been reported from the earthquake struck region despite the maximum measured PGA of 643 cm/s^2 (E-W direction) at the AFAD station located 6,5 km away from the epicenter.

- The felt records of EMSC-CSEM indicates that felt area extends up to 300 km to the shorelines of Black Sea and 600 km to the South, in the vicinity of Beirut.

02| Main seismic features of the event: aftershocks

- There are several moderate-size earthquakes (magnitudes between Mw 5,5 and Mw 6,0) located in between the EAF Zone and Malatya Fault that occurred after the 2023 Kahramanmaraş duplets (Figure 3). These can be classified as the aftershocks of the 2023 Kahramanmaraş earthquake sequence. The size and location of the last event (i.e., the Akuşağı-Kale earthquake -No:12 in Table 2 and Figure 3-) resembles another aftershock activity of the 2023 Kahramanmaraş duplets.

- The active fault map of MTA (the General Directorate of Mineral Research and Exploration) does not show a distinct active fault segment representative of this recent seismic activity. Nevertheless, MTA points out a suspicious fault based on morphological expressions in the region that shows no Quaternary movements. (This fault is shown in Figure 3 next to the recent Akuşağı-Kale earthquake designated by number 12).

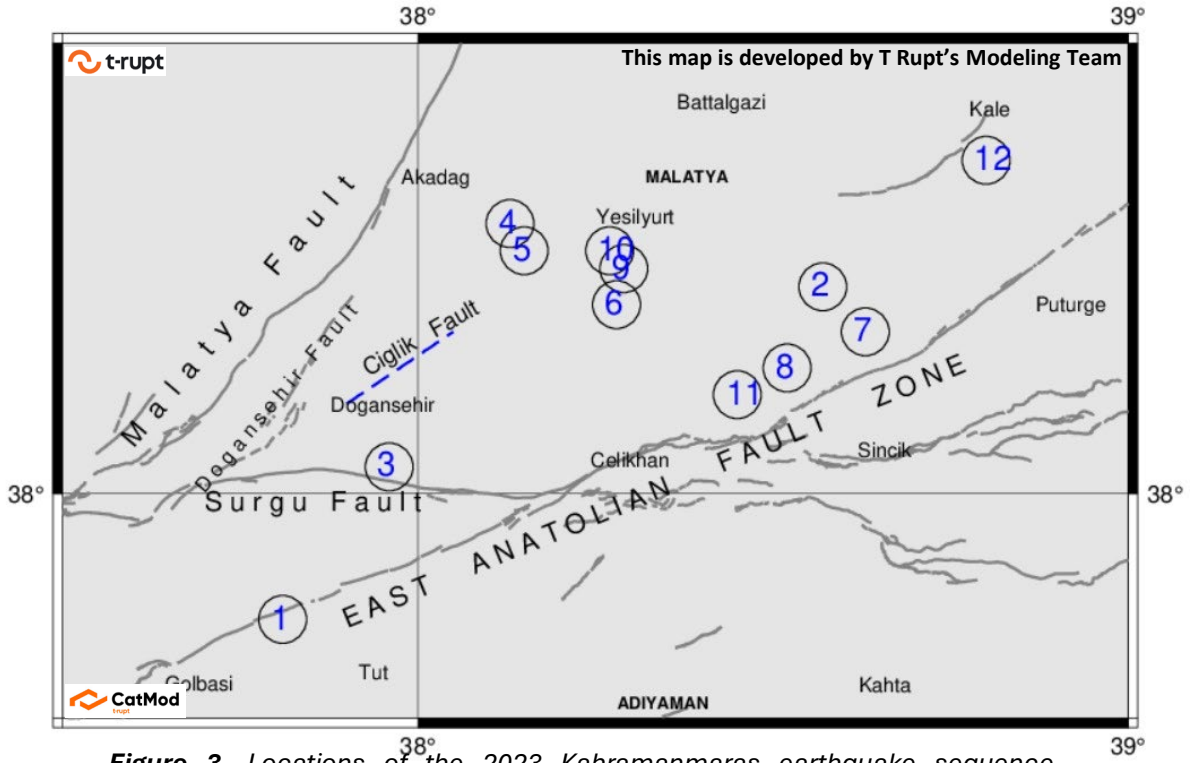


Figure 3. *Locations of the 2023 Kahramanmaraş earthquake sequence aftershocks in the region of interest*

Table 2. *Moderate-size events around Malatya following the 2023 Kahramanmaraş (M7.8) and Ekinözü (M7.7) earthquakes*

No	Date	Origin Time	Latitude	Longitude	Depth	Magnitude
1	06.02.2023	05:03:37	37.86	37.81	5	5.5
2	06.02.2023	06:18:46	38.23	38.57	10	5.0
3	06.02.2023	13:26:48	38.03	37.96	20	6.0
4	06.02.2023	13:51:32	38.30	38.13	8	5.7
5	06.02.2023	18:33:34	38.27	38.15	10	5.4
6	06.02.2023	23:53:24	38.21	38.28	10	5.0
7	07.02.2023	10:11:15	38.18	38.63	10	5.4
8	07.02.2023	13:18:15	38.14	38.52	10	5.4
9	27.02.2023	12:04:51	38.25	38.29	5	5.2
10	10.08.2023	20:48:00	38.27	38.265	11	5.2
11	25.01.2024	16:04:04	38.20	38.46	14	5.2
12	**16.10.2024**	**07:46:31**	**38.37**	**38.80**	**10**	**6.0**

02| Main seismic features of the event: aftershock features

- The Akuşağı-Kale earthquake is located in the proximity of the northern-rupture termination zone of the 2023 Kahramanmaraş earthquake sequence (Green star in Figure 4). Such a distribution suggests that this event is as part of the aftershock sequence of the 2023 Kahramanmaraş duplets.

- The first two-day aftershock activity after the major earthquake extends in the northeast-southwest and northwest-southeast directions. The current aftershock distribution suggests that the Mw 5,9 event can occur on either of the conjugate fault planes (Planes 1 and 2) that are given in the fault-pane solution by GCMT (inset picture in Figure 5). The dashed white lines in Figure 5 shows the conjugate fault planes. The actual ruptured plane will be more definitive in the next few weeks with the accumulated aftershock data.

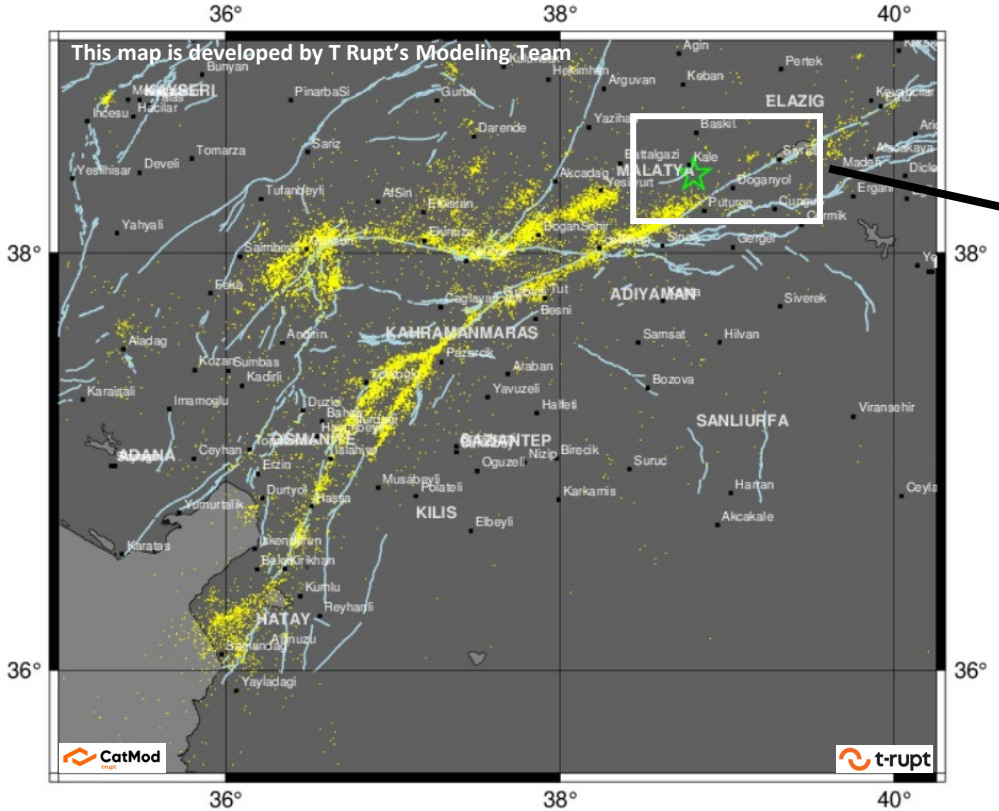


Figure 4. *Aftershock activity of the* 2023 Kahramanmaraş earthquake sequence. *The blow-up view of the area encompassed by white rectangle is presented in Figure 5. (Source of aftershock locations: Boğaziçi University Observatory and Earthquake Research Institute)*

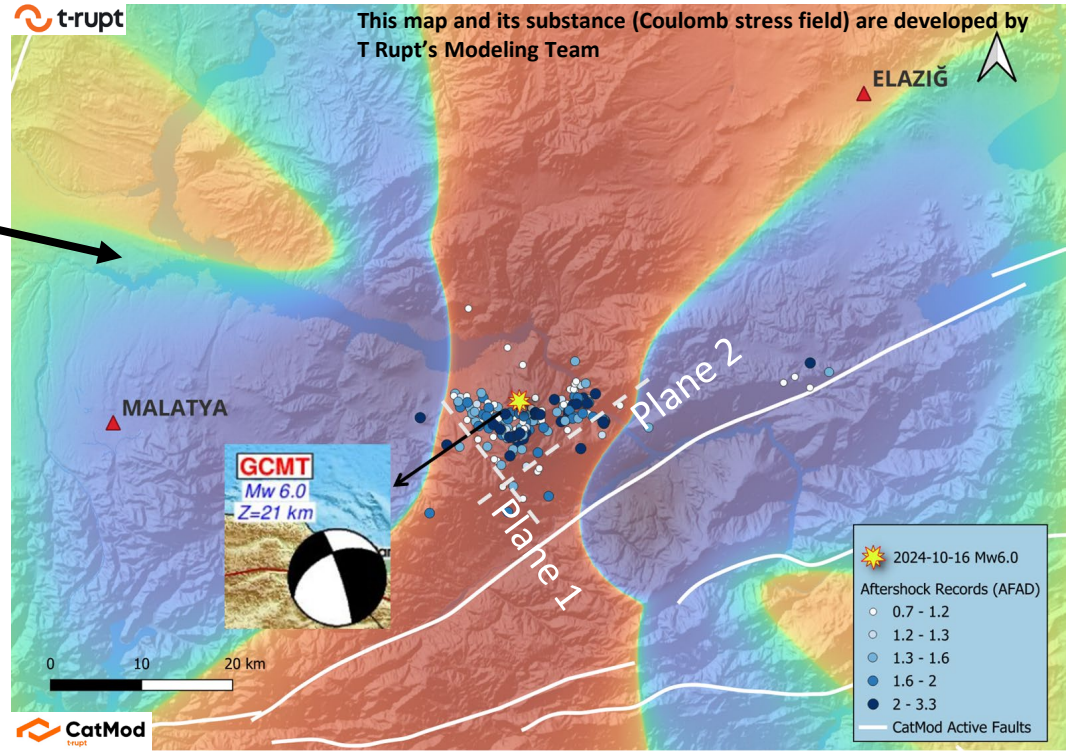
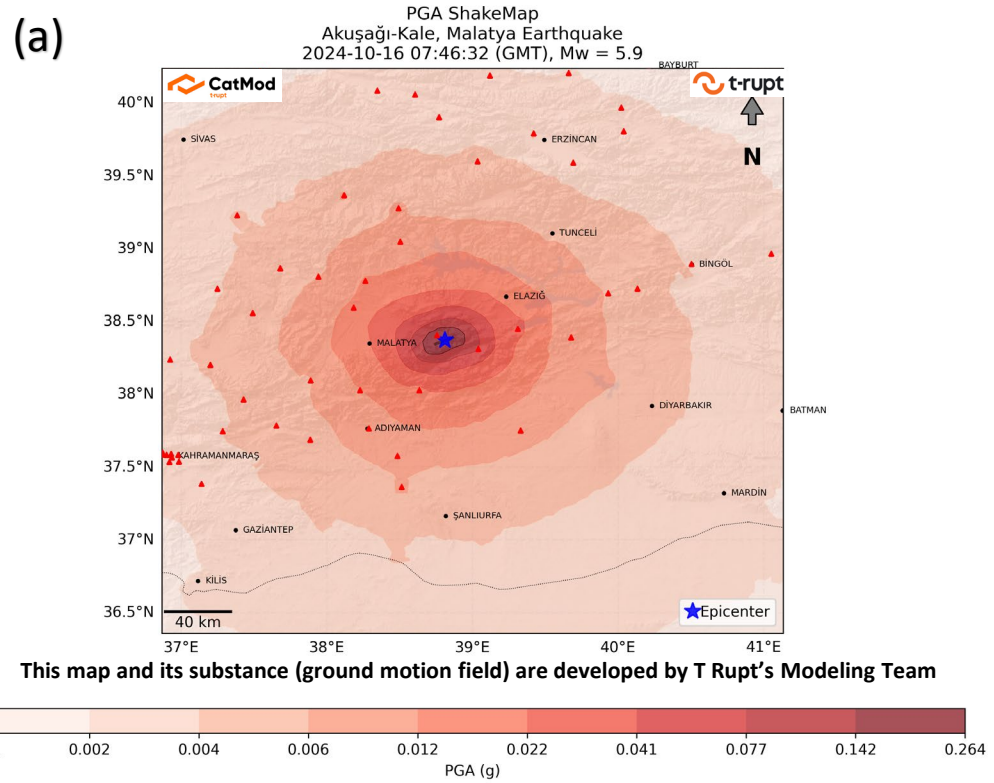


Figure 5. *Aftershock distribution of the Akuşağı-Kale earthquake (as of 17 October 2024). The GCMT solution of the Mw 5,9 event is shown on the lower left corner of Figure 5 as an inset. The red and blue shaded area indicates stress increased, and decreased areas, respectively.*

02| Main seismic features of the event: ground motion field

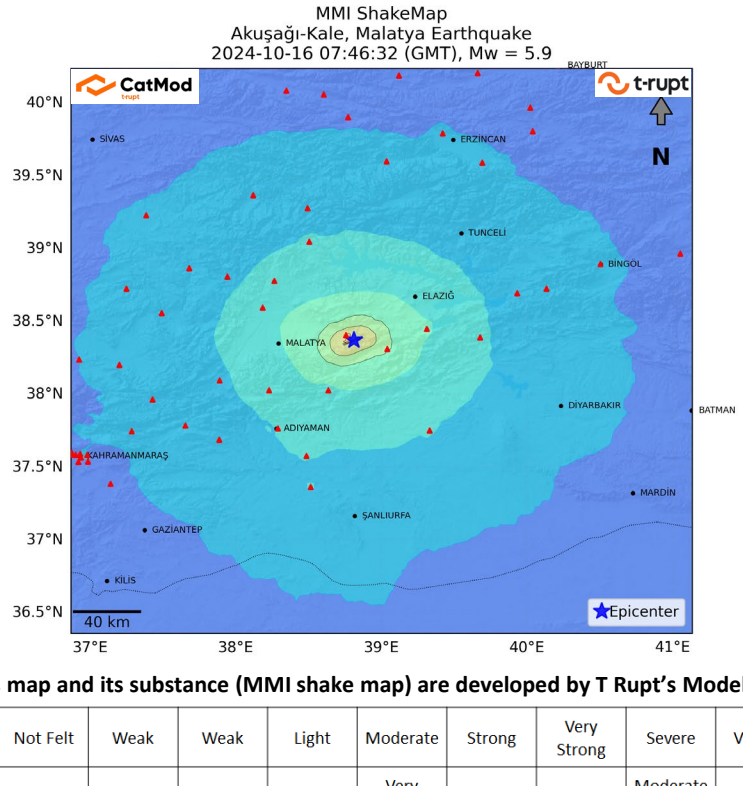
Figure 6 shows the ShakeMaps of this event for peak ground acceleration (PGA) (Figure 6a) and modified Mercalli intensity (MMI) (Figure 6b). (Plane 2 in Figure 5 in Slide #6 is taken as the basis for the ground motion fields). The ground-motion fields are conditioned on the station recordings provided from the AFAD database. The median PGA reaches to 0,317g in the vicinity of the Kale district, whereas the MMI value is computed as VIII in the same region. The stations used in generating ShakeMaps are represented by red triangles on the maps. The MMI distribution (Figure 6b) indicates that the damage potential of this event in the vicinity of urban settlements (mainly Malatya and Elazığ) ranges between very light to moderate.

(a)



This map and its substance (ground motion field) are developed by T Rupt's Modeling Team

(b)



This map and its substance (MMI shake map) are developed by T Rupt's Modeling Team

Felt Shaking	Not Felt	Weak	Weak	Light	Moderate	Strong	Very Strong	Severe	Violant	Extreme
Potential Damage	None	None	None	None	Very Light	Light	Moderate	Moderate Heavy	Heavy	Very Heavy
Instrumental Intensity	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X+**

Figure 6. *(a) sampled PGA ground-motion field in g*, (b) *MMI ShakeMaps for* the October 16th, 2024 Akuşağı-Kale, Malatya earthquake. Ground Motion fields are conditioned on the measured PGA values given in AFAD

References

- AFAD, Disaster and Emergency Management Presidency, Ministry of Interior of Republic of Türkiye, last accessed on Oct. 17th, 2024. https://tadas.afad.gov.tr/event-detail/32756
- EMSC, European Mediterranean Seismological Centre, (last accessed on Oct. 17th, 2024). https://www.emsc-csem.org/Earthquake_information/earthquake.php?id=1718397
- USGS, United States Geological Survey, (last accessed on Oct. 17th, 2024). https://earthquake.usgs.gov/earthquakes/eventpage/us6000nyzk/executive

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