Web-based macroseismic intensity study in Turkey – entries on Ekşi Sözlük

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INTRODUCTION

Internet users in Turkey are also sharing their experiences of earthquakes in other websites such as Ekşi Sözlük. Ekşi Sözlük is a collaborative dictionary. To be a full member of the website, newly registered users are required to write 10 entries on existing topics. Then, the entries are analyzed according to the rules of the site. By doing that, Ekşi Sözlük provides relatively reliable information to the visitors. It was the 14th most visited website in Turkey in 2019. Even though there are entries in other languages, the main language used on the website is Turkish.
Users of the website create topics on earthquakes that they have felt and also for major earthquakes occurring around the world.

METHODS AND MATERIALS

To analyze the entries in the earthquake topics, 20 titles with the highest number of entries for earthquakes that have occurred in western Turkey and the surrounding area are selected
These entries are labeled according to the modified Mercalli–Cancani–Sieberg (MCS) scale.
For each event, analyzed entries are compared with reference instrumental intensity values. Instrumental intensity is a forecast of the macroseismic intensity and is calculated as a function of input ground motion parameters. Instrumental intensity is defined following the methodology from Cataldi et al. (2021).

Istanbul earthquake – 26 September 2019

There are 233 entries with city and district information. A minaret of a mosque in the Avcılar district of Istanbul collapsed and more than 450 buildings were damaged.
In Silivri, Büyükçekmece, and Avcılar districts, maximum MCS from the entries are labeled as 6. The intensity map predicts MCS 4.5 for the Avcılar district. Local soil conditions may have a role on the exaggerated intensities in the entries written in Avcılar.

In the Beşiktaş district, a maximum MCS of 5 is given in three entries. All of them are due to the evacuation of the buildings. A total of two of these entries are from high-rise office buildings, which probably caused extra panic due to the swaying of the tall buildings. The evacuation was also influenced by panic and is also one of the reasons for the maximum MCS of 5 that was given in the entries from the Fatih, Beyoğlu, and Kadıköy districts. In the Kartal district, MCS is 5 is due to objects falling from shelves.

Ankara earthquake – 25 August 2019

There are 129 entries with city and district information. The depth of the earthquake is measured as being 5 km. Even though there are large number of magnitude 3.5 earthquakes in Turkey, this was felt by many inhabitants since the hypocenter was located beneath the city of Ankara, and the earthquake had a shallow hypocentral depth. Due to the shallow depth, almost all districts provided relatively higher maximum MCS values.

I	1	2	3	4	5	6	7	8	9	10
PGA_{min} (cm s^{-2})		0.32	1.91	6.31	17.78	52.48	85.11	141.25	269.15	575.44
PGA_{max} (cm s^{-2})	< 0.32	1.91	6.31	17.78	52.48	85.11	141.25	269.15	575.44	1148.15
PGV_{min} (cm s^{-1})		0.01	0.10	0.28	0.74	2.57	5.75	9.77	21.38	39.81
PGV_{max} (cm s^{-1})	< 0.01	0.10	0.28	0.74	2.57	5.75	9.77	21.38	39.81	70.789

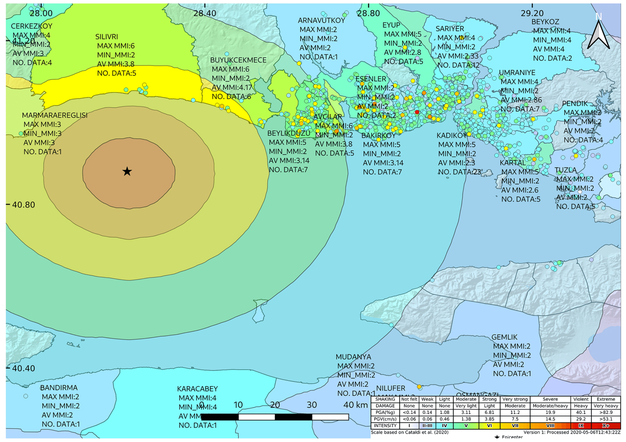

Figure 1: Intensity map of the 26 September 2019 Istanbul earthquake with labeled entries. Entries are plotted to district level polygons. Felt reports of the earthquake submitted to EMSC are at the top of the labeled entries.

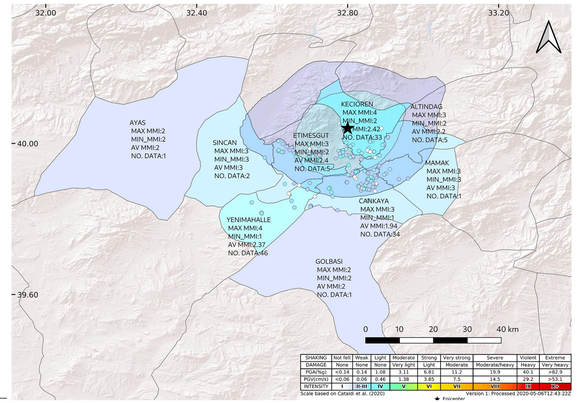

Figure 2: Intensity map of the 25 August 2019 Ankara earthquake with labeled entries. Entries are plotted to district level polygons. Felt reports of the earthquake submitted to EMSC are at the top of the labeled entries

RESULTS

It is found that residuals tend to increase with increasing distance. In longer distances, MCS values are more likely to be 1. When there is an entry which states the feeling of the earthquake, it is more likely to have MCS value of 2. This is due to the fact that it is hard to distinguish between MCS 1 and MCS 2 by analyzing the entries. A lack of resolution in terms of expression of the experience limits our distinction levels of intensity. The website is not dedicated to providing exact information on earthquakes.

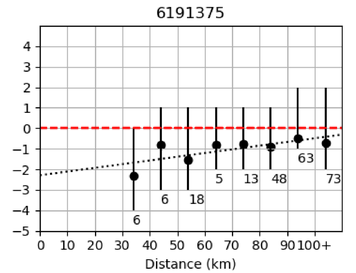

Figure 3: Residuals of predicted and observed MCSs in Istanbul earthquake – 26 September 2019. Red dashed line represents the baseline. Black circles are the residual of the weighted average of the bin. Vertical black lines are the residuals from predicted MCSs and minimum and maximum MCSs that are observed in the bin. The black dotted line is the fitted line to the residual of weighted averages. The number of data points inside the bins is provided beneath each bin point with data

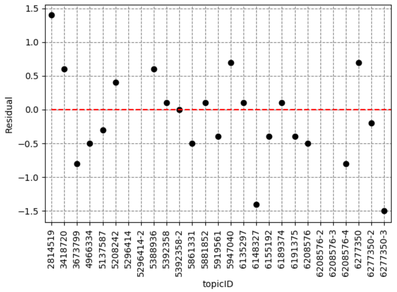

Figure 4: Residuals of measured magnitudes of the earthquakes with average magnitude guesses from users. Earthquakes without any guesses are blank

DISCUSSION

The Silivri district of Istanbul has all of the EMSC data from the coastline. However, it is located in the northern part of the district, for which MCS value is one integer lower with respect to the highly populated coastal area.

Despite not having the exact location and having to work with the subjective feelings of the users, it is found that the districts with loose soils have relatively bigger maximum MCS values.

Entries that are written from high-rise buildings showed that the users were affected more due to the tendency of these buildings to amplify the motions over longer periods (e.g., the Beşiktaş district during the Istanbul earthquake). Another reason for the higher intensities experienced, with respect to the predicted ones, is the stress experienced during the evacuation of buildings (even if it is not necessary to evacuate).

For the Ankara earthquake on 20 August 2019, there is a large gap between the predicted and observed MCSs. This is due to the fact that the people of the city of Ankara are not as used to feeling earthquake as people in seismically active cities such as Izmir, Istanbul, and Yalova.

Users living in seismically active regions such as Istanbul, Dardanelles, and Izmir are more likely to feel more earthquakes that occurred at different epicentral distances and magnitudes. On the other hand, users living in regions with lower seismicity, e.g., Ankara, do not have large number of experiences and may think that, when they feel an earthquake, it must be a major one since they do not know the feeling of low-magnitude earthquake.

CONCLUSIONS

In conclusion, entries on the Ekşi Sözlük site can provide intensity distributions of earthquakes with limits. Entries are written in free form, which creates uncertainties in the MCS labeling process. Entries do not reveal the exact position of the data provider, which makes it hard to analyze the differences between observed and predicted MCS values. Despite the limitations, the gathered data have similarities with the predictions. The website can provide near-real-time intensity information after an earthquake.

REFERENCES 1. Cataldi, Laura, Lara Tiberi, and Giovanni Costa. "Estimation of MCS intensity for Italy from high quality accelerometric data, using GMICEs and Gaussian Naïve Bayes Classifiers." Bulletin of Earthquake Engineering 19.6 (2021): 2325-2342.