Tsinghua University

RED-ACT Report

Real-time Earthquake Damage Assessment using City-scale Time-history analysis

May 25, M5.1 Japan Chiba-ken Earthquake

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Acknowledgments and Disclaimer

The authors are grateful for the data provided by K-NET and KiK-net. This analysis is for research only. The actual damage resulting from the earthquake should be determined according to the site investigation.

Scientific background of this report can be found at:

http://www.luxinzheng.net/software/Real-Time_Report.pdf

1. Introduction to the earthquake event

At 15:20 25 May 2019 (Local Time, UTC +9), an M 5.1 (JMA) earthquake occurred in Japan Chiba-ken. The epicenter was located at 140.3 35.3, with a depth of 40.0 km.

2. Recorded ground motions

15 ground motions near to epicenter of this earthquake were analyzed. The names and locations of the stations can be found Table 1. The maximal recorded peak ground acceleration (PGA) is 151 cm/s/s. The corresponding response spectra in comparison with the design spectra specified in the Chinese Code for Seismic Design of Buildings are shown in Figure 1.

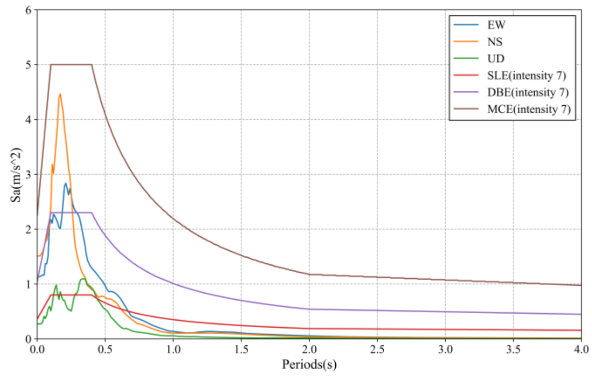


Figure 1 Response spectra of the recorded ground motions with maximal PGA

3. Damage analysis of the target region subjected to the recorded ground motions

Using the real-time ground motions obtained from the strong motion networks and the **city-scale nonlinear time-history analysis (see the Appendix of this report),** the damage ratios of buildings located in different places can be obtained. The building damage distribution and the human uncomfortableness distribution near to different stations is shown in Figure 2 and Figure 3, respectively. These outcomes can provide a reference for post-earthquake rescue work.

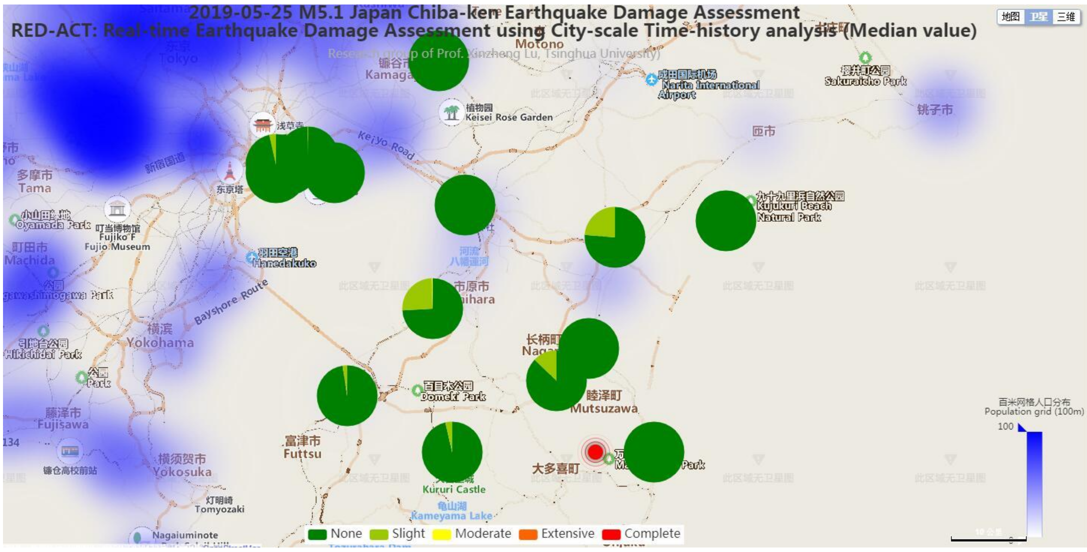


Figure 2 Damage ratio distribution of the buildings near to different stations

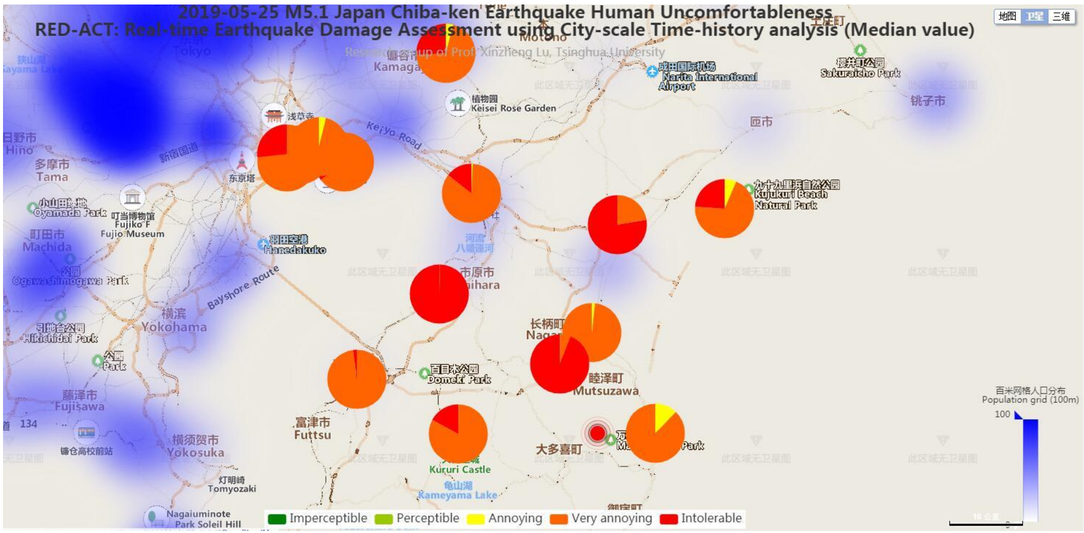
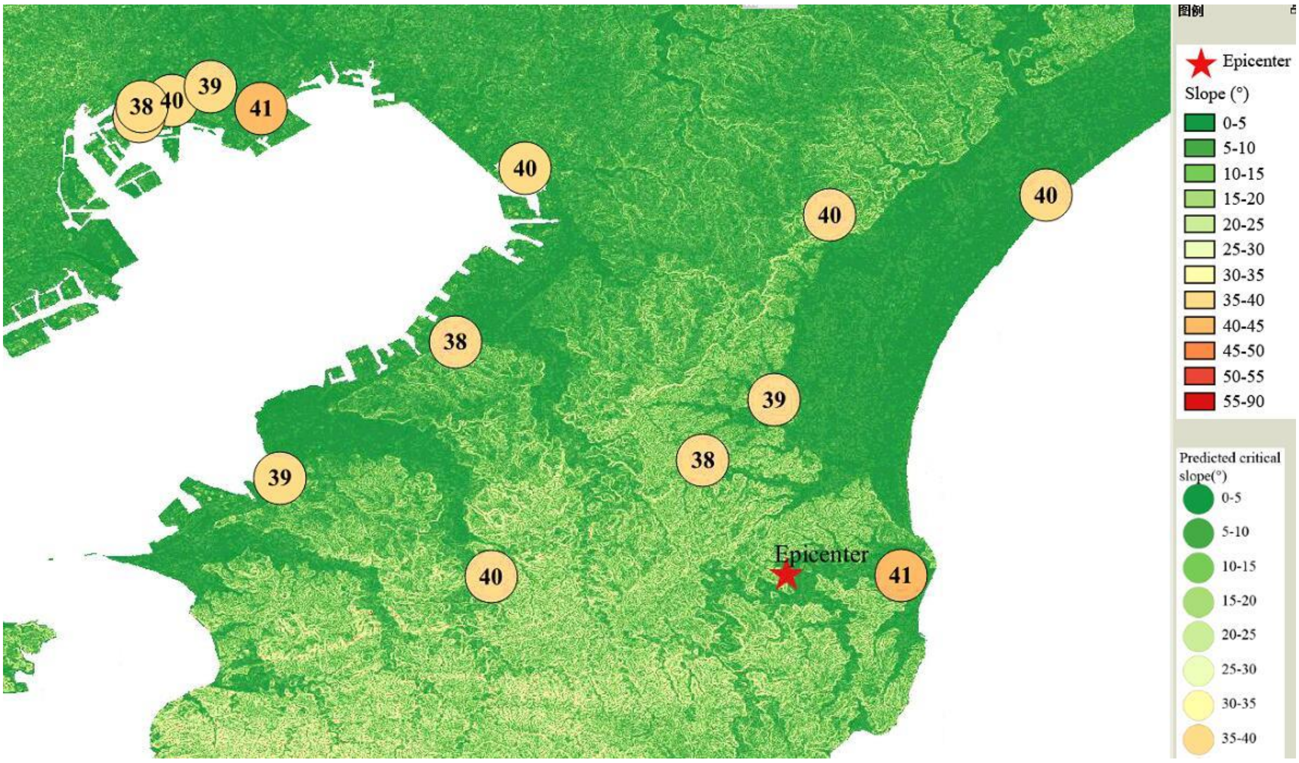


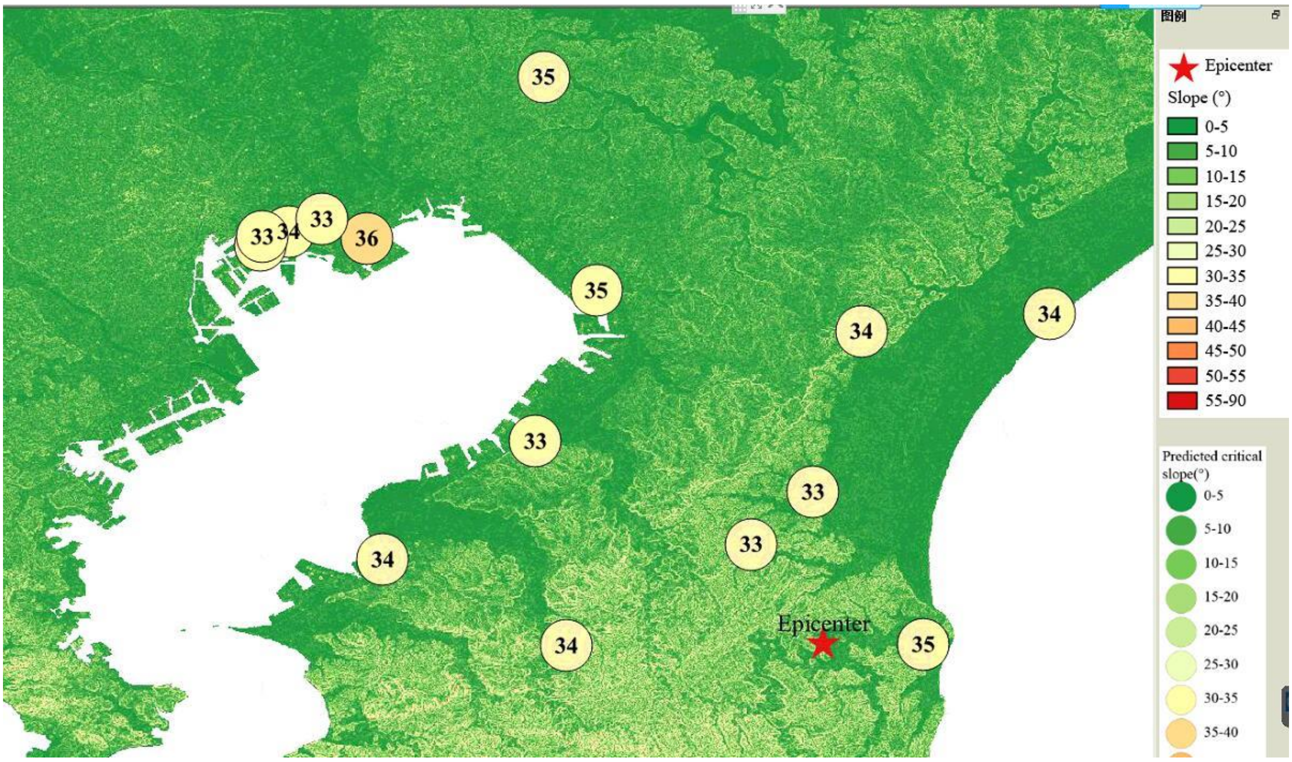
Figure 3 Human uncomfortableness distribution near to different stations

4. Earthquake-induced landslide of the target region subjected to the recorded ground motions

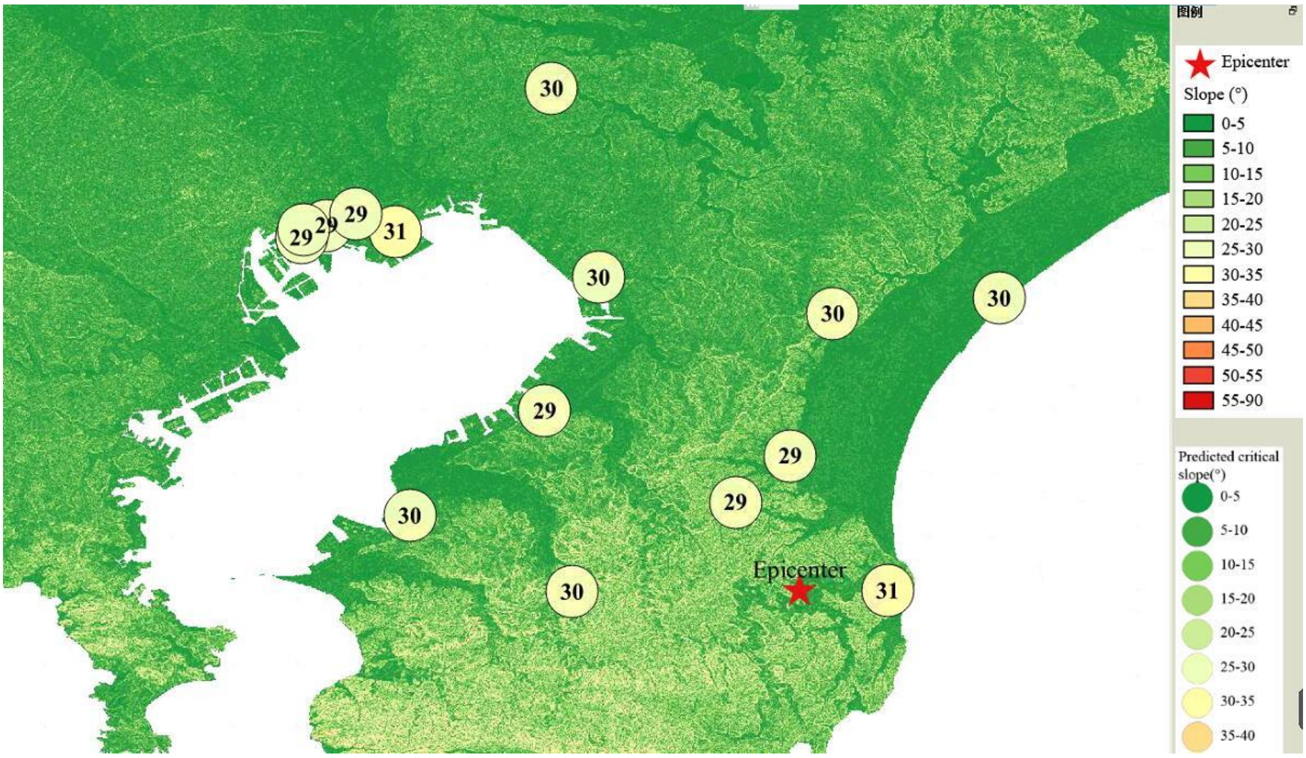
According to local topographic data, lithology data and ground motion records, the distribution of earthquake-induced landslide near to different stations under the different proportions of the landslide slab thickness that is saturated can be calculated, as shown in Figure 4. The basemap shows the distribution of the local slope. The number in the circle represents the critical slope of the landslide. The earthquake-induced landslide tends to occur with a higher probability when the slope near the station is larger than this threshold value.



(a) The proportion of the landslide slab thickness that is saturated equals 0%



(b) The proportion of the landslide slab thickness that is saturated equals 50%



(c) The proportion of the landslide slab thickness that is saturated equals 90%

Figure 4 Distribution of earthquake-induced landslide near to different stations

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Table 1 Names and locations of the strong motion stations

No.	Station Name	Longitude	Latitude
1	CHB003	140.056	35.7943
2	CHB008	139.902	35.6537
3	CHB009	140.102	35.6082
4	CHB011	140.497	35.5877
5	CHB012	140.333	35.5727
6	CHB013	140.291	35.4327
7	CHB014	140.049	35.4769
8	CHB015	139.916	35.3738
9	CHB016	140.387	35.2999
10	CHB017	140.076	35.2988
11	CHB026	140.237	35.3872
12	TKY013	139.834	35.6596
13	TKY017	139.809	35.6474
14	TKY018	139.811	35.6551
15	TKY026	139.863	35.6704