RED-ACT Report

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

June 17, M5.2 Japan Ibaraki-ken Hokubu 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 08:00 JST 17 2019 (Local Time, UTC +9), an M 5.2 (JMA) earthquake occurred in Japan Ibaraki-ken Hokubu. The epicenter was located at 140.6 36.5, with a depth of 80.0 km.

2. Recorded ground motions

35 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 234 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.

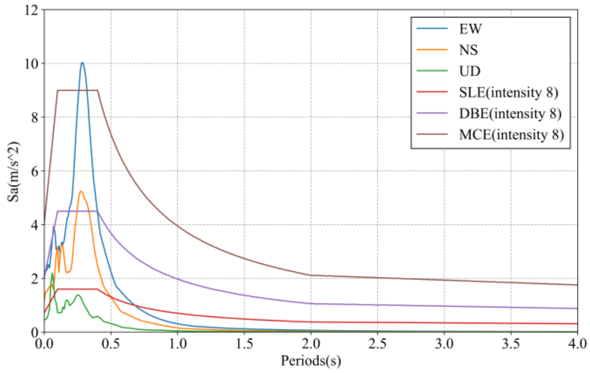


Figure 1 Response spectra of the recorded ground motions with maximal PGA

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.

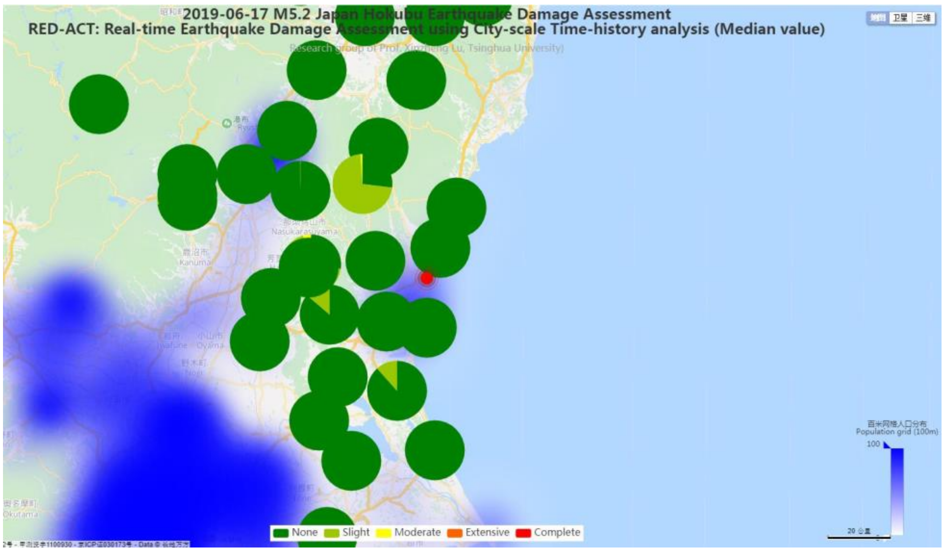


Figure 2 Damage ratio distribution of the buildings near to different stations

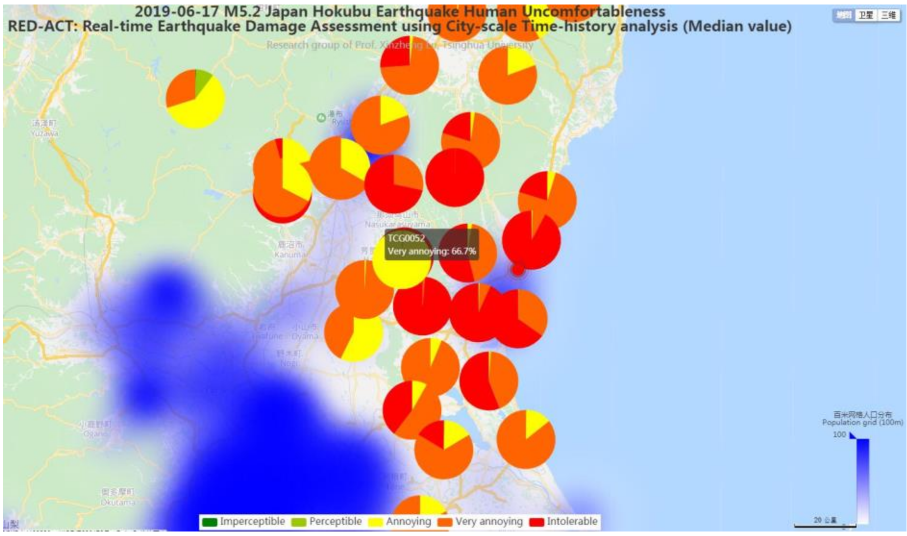
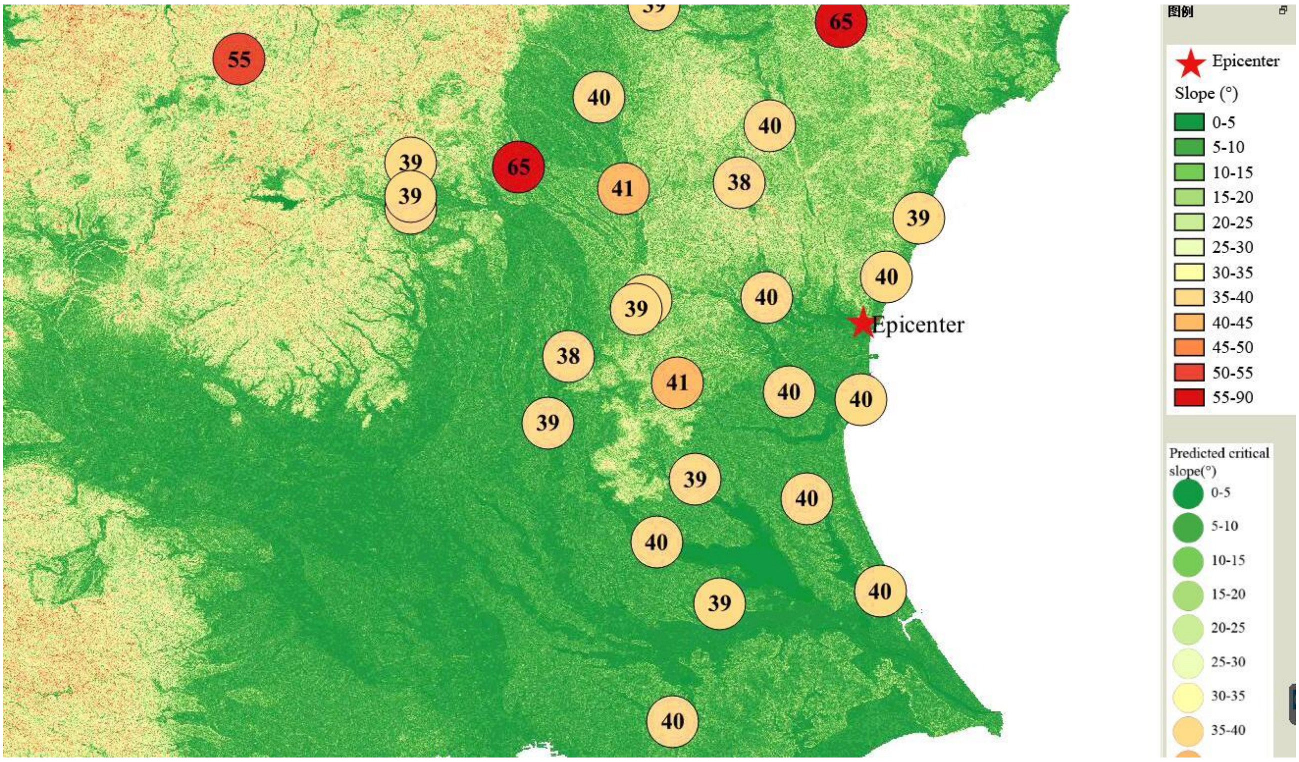


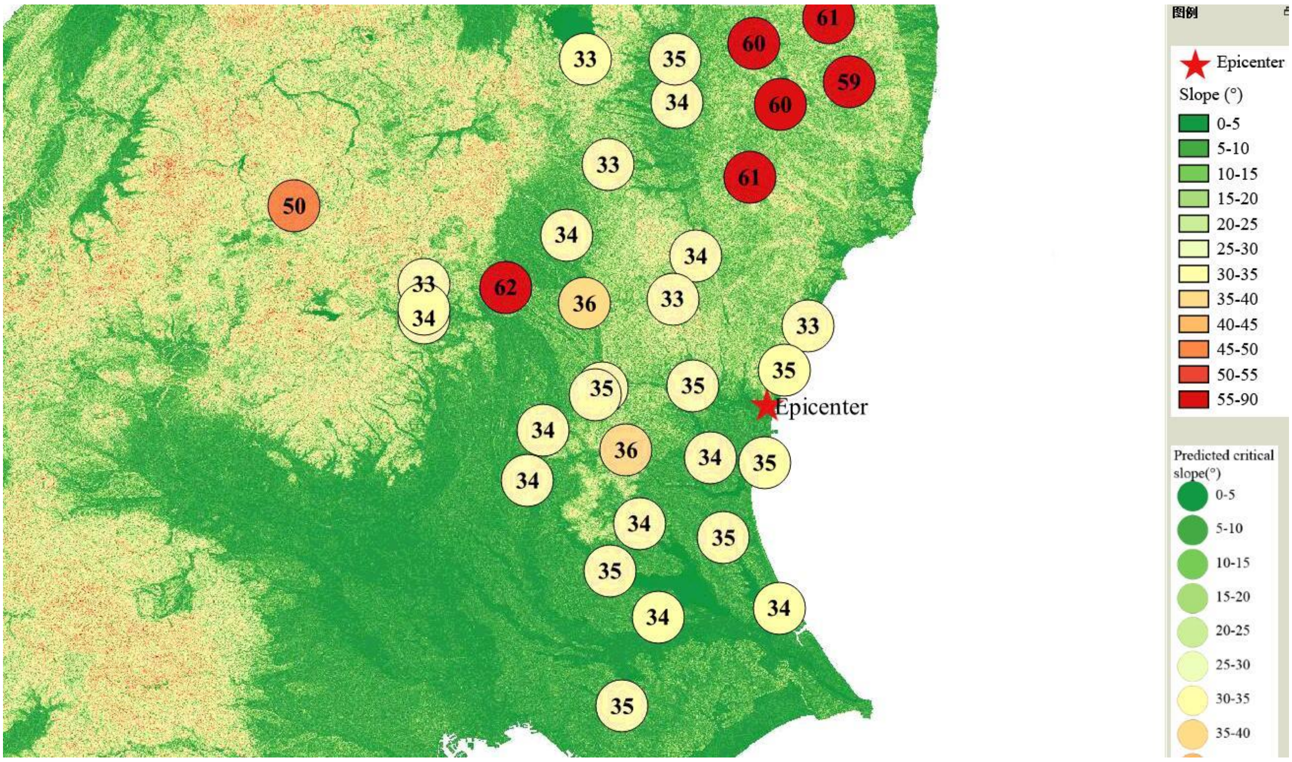
Figure 3 Human uncomfortableness distribution near to different stations

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

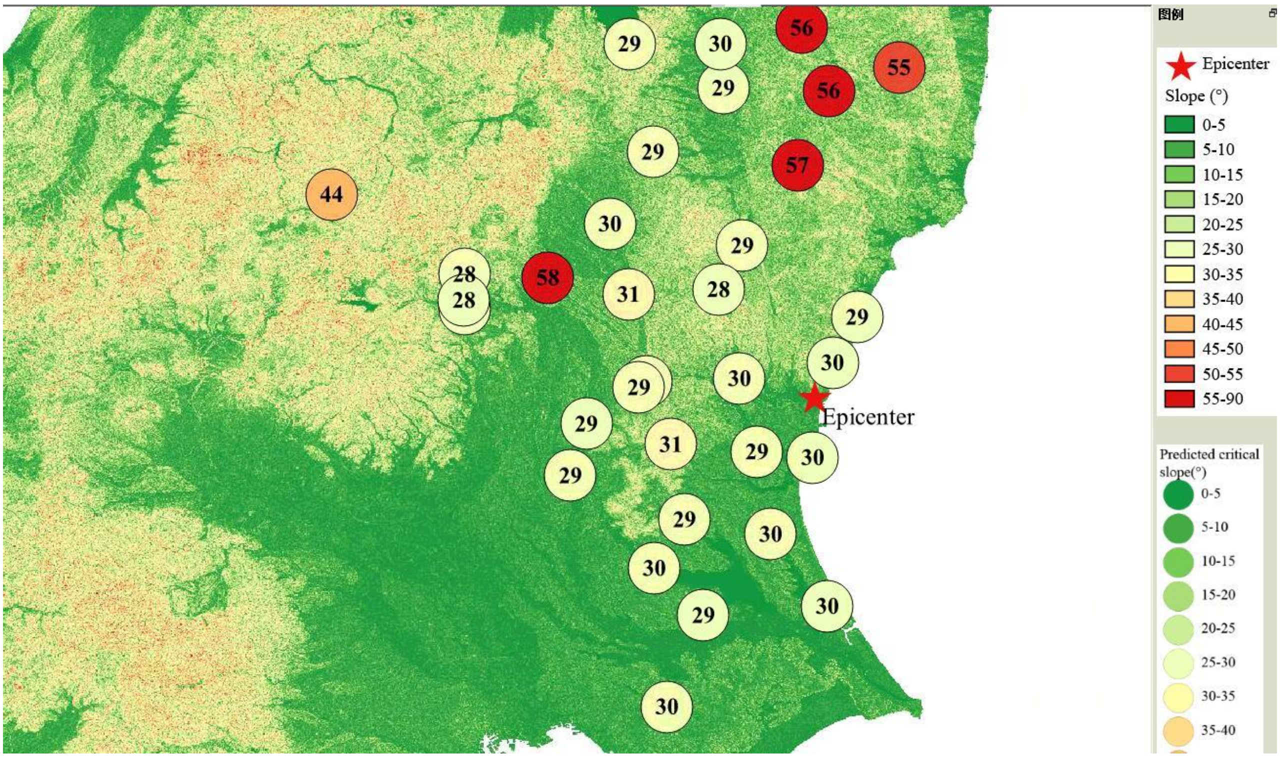
According to local topographic data, lithology data and ground motion records, the distribution of earthquake-induced landslide near to different stations under the different proportions of the landslide slab thickness that is saturated can be calculated, as shown in Figure 4. The basemap shows the distribution 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	CHB007	140.227	35.7234
2	FKS006	140.759	37.5031
3	FKS008	140.567	37.4363
4	FKS009	140.635	37.2778
5	FKS013	140.556	37.09
6	FKS014	140.417	36.8864
7	FKS016	140.191	37.1228
8	FKS017	140.369	37.2842
9	FKS018	140.362	37.3961
10	FKS019	140.437	37.603
11	FKS024	140.132	37.3957
12	FKS029	139.38	37.0159
13	FKS031	140.813	37.3364
14	IBR001	140.357	36.7761
15	IBR002	140.707	36.7061
16	IBR003	140.645	36.5915
17	IBR004	140.41	36.5516
18	IBR005	140.237	36.3851

19	IBR006	140.454	36.3665
20	IBR007	140.595	36.3523
21	IBR008	139.983	36.3062
22	IBR012	140.271	36.1954
23	IBR013	140.489	36.1587
24	IBR014	140.195	36.0729
25	IBR017	140.319	35.9537
26	IBR018	140.632	35.977
27	TCG001	140.083	36.9417
28	TCG003	139.715	36.8144
29	TCG005	139.926	36.8061
30	TCG006	140.13	36.7639
31	TCG009	139.715	36.7258
32	TCG013	140.023	36.4368
33	TCG014	140.174	36.545
34	TCG015	139.714	36.7489
35	TCG016	140.156	36.5287