

Overview: Kumamoto Earthquakes in 2016

On 14 and 16 April 2016, earthquakes occurred in the middle of Kyushu Island, in southwestern Japan, measuring seven (the highest level) on the seismic intensity scale of the Japan Meteorological Agency (JMA). The quakes caused 137 deaths in Kumamoto prefecture including those passed due to the injury or stress after the disaster and 8,329 houses were totally destroyed in Kumamoto and Oita Prefectures.

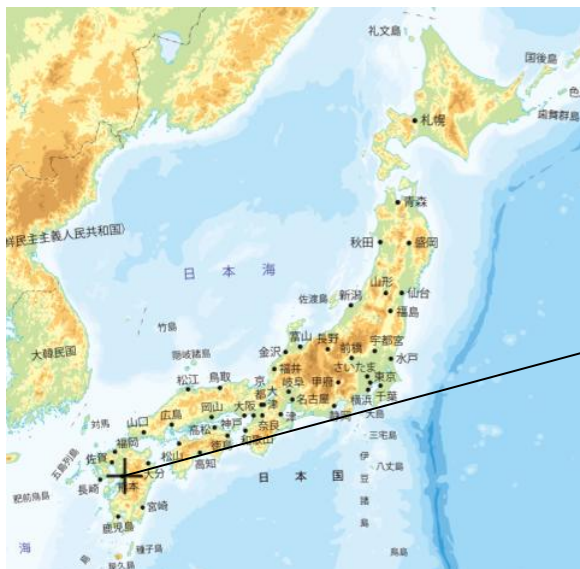
1. Outline of the 2016 Kumamoto Earthquakes

The first quake (foreshock) occurred on 14 April 2016 at 21:26 in Kumamoto Prefecture. The epicenter was at 32°44.5'N, 130°48.5'E, at a depth of about 11 km below ground and the magnitude measured 6.5 (Mj). An earthquake with a JMA seismic intensity of 7 was recorded in Mashiki Town.

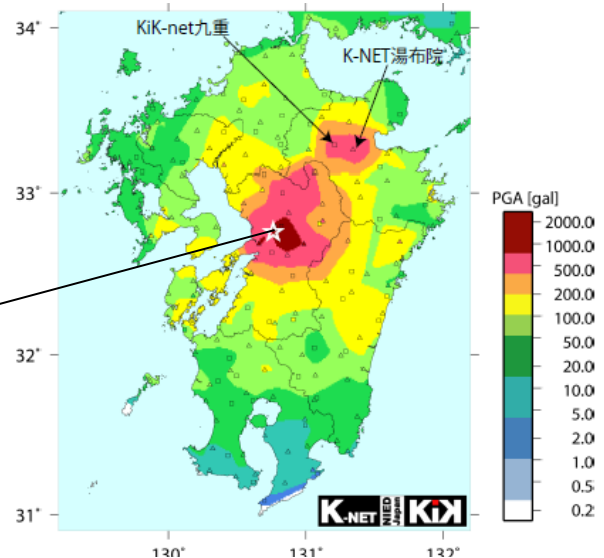
About 28 hours later, the second quake (main shock) occurred on 16 April 2016 at 01:25 in Kumamoto Prefecture. The epicenter was 32°45.2'N, 130°45.7'E at a depth of about 12 km, with the magnitude measuring 7.3 (Mj). A JMA seismic intensity of 7 was recorded in Mashiki Town and Nishihara Village. Mj7.3 is the same magnitude recorded during the Great Hanshin-Awaji Earthquake in 1995. Also, this was the first time that two successive magnitude 7 earthquakes were recorded back-to-back in Japan. These Kumamoto Earthquakes are considered to have been connected, with the foreshock recorded at the northern end of the Hinagu fault, and the main shock recorded at the Futagawa fault.

Source: Headquarters for Earthquake Research Promotion

http://www.static.jishin.go.jp/resource/monthly/2016/2016_kumamoto_3.pdf



Source: Geospatial Information Authority of Japan



Source: National Disaster Institute for Earth Science and Disaster Resilience

2. Outline of Damages and Status of Recovery

Human Casualties

The total number of deaths in Kumamoto Prefecture was 139, with 974 severely injured and 1,433 slightly injured as of 14 November 2016.



Table 1 Human Casualties (persons)

| Pref. | Deaths | Severely Injured | Slightly Injured |
|--------------|------------|------------------|------------------|
| Fukuoka | 0 | 1 | 17 |
| Saga | 0 | 4 | 9 |
| Kumamoto | 137 | 974 | 1,433 |
| Oita | 0 | 11 | 22 |
| Miyazaki | 0 | 3 | 5 |
| Total | 137 | 993 | 1,486 |

Source: Emergency Disaster Response Headquarters

Note: Another eight deaths are considered to be quake-related deaths due to exacerbation of injuries caused by the disasters or diseases caused by physical burden after the earthquake events (The determination of disaster related deaths will be determined by municipal screening boards. And 138 injured persons in Kumamoto are have not yet been classified.)

Building Damage

Housing damage statistics show that across seven prefectures, there 8,329 houses totally destroyed, 31,692 houses half destroyed, and 143,651 houses partially destroyed as of 14 November 2016. Most of the totally destroyed buildings were in Kumamoto Prefecture, just as were most of the human casualties. As many as 311 public buildings were damaged in Kumamoto Prefecture alone.

The five municipalities of Kumamoto Prefecture have resumed operations at locations outside of their city halls due to damage (as of 14 November 2016).

- Yatsushiro City: To a temporary city hall and Sencho branch office
- Hitoyoshi City: To City hall Annex, Sport Palace, and the Culture Palace
- Uto City: To a temporary city hall
- Ozu Town: To public facilities (Okusu Plaza) and a prefabricated temporary city hall
- Mashiki Town: To central community center and a prefabricated temporary city hall

Table 2 Building Damage (Buildings)

| Prefecture | Housing | | | Non-Residential Buildings | | Fires |
|--------------|-------------------|----------------|---------------------|---------------------------|--------------|-----------|
| | Totally destroyed | Half destroyed | Partially destroyed | Public buildings | Others | |
| Yamaguchi | | | 3 | | | |
| Fukuoka | | 1 | 230 | | 1 | |
| Saga | | | 1 | | 2 | |
| Nagasaki | | | 1 | | | |
| Kumamoto | 8,320 | 31,475 | 135,613 | 311 | 4,185 | 15 |
| Oita | 9 | 214 | 7,783 | | 60 | |
| Miyazaki | | 2 | 20 | | | |
| Total | 8,329 | 31,692 | 143,651 | 311 | 4,248 | 15 |

Source: Emergency Disaster Response Headquarters

Lifelines

Table 3 Lifeline Damage and Recovery

| | Peak damage | Recovery situation |
|-------------|--------------------------------------|--|
| Electricity | 474,000 units blackout (16 Apr.) | Mostly restored as of 20 Apr., full restoration as of 27 Apr. |
| Gas | 105,000 units outage (16 Apr.) | Full restoration at 30 Apr. |
| Water | 445,857 units water outage (16 Apr.) | Mostly restored at 28 July, except in severely affected areas (approx. 560 houses) |
| Oil | 104 Service Stations closed | More than 90% working as of 14 November |

Source: Emergency Disaster Response Headquarters

Transportation

Table 4 Transportation System Damage and Recovery

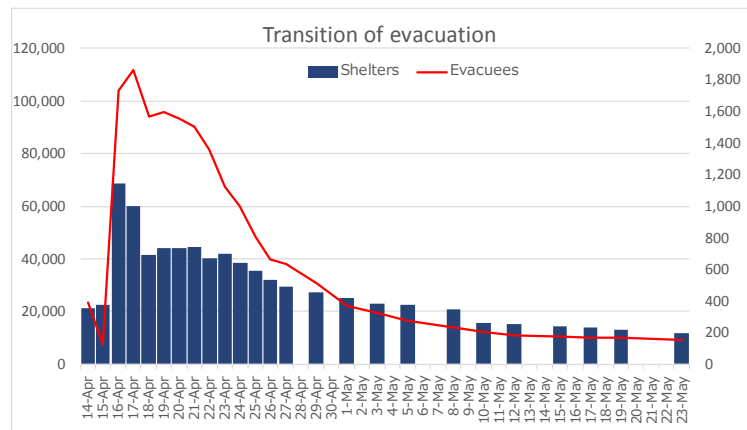
| | Peak damage | Recovery situation |
|-------------------------|---|--|
| Highways | Many road surfaces damaged, 33 sections of bridge damaged, landslides | All traffic regulations have been canceled as of 29 Apr. |
| National roads | Displacements and landslides in 15 locations | As of 14 November, four sections are blocked, bypass route available |
| Railways | Much damage to private railway tracks, facilities, and stations | As of 14 Nov., service remains suspended on two lines |
| Shinkansen bullet train | Deadhead train was derailed, tracks and Kumamoto station were damaged | Full restoration as of 27 Apr. |
| Airports | Kumamoto airport was closed on 16 Apr. | All the domestic flights are in service as of 2 Jun. and some international flights as of 3 Jun. |
| Ports | Four major ports affected | Mostly restored, except two areas in Beppu Port (as of 14 Nov.) |

Source: Emergency Disaster Response Headquarters

Evacuation Situation

Affected municipal governments provided gymnasiums and other public buildings for use as public shelters for affected residents who could not live in their damaged houses in Kumamoto, Oita, Nagasaki, and Fukuoka Prefectures. The peak numbers recorded were 855 shelters and 183,882 evacuees as of 17 April. There were one shelter and three evacuees in Kumamoto as of 14 November. Public shelters except Kumamoto Pref. were closed by 16 May.

Figure 1 Evacuation Situation



Source: Emergency Disaster Response Headquarters



Other Damage: Landslides

Many landslides occurred due to the earthquakes. As many as 190 sediment-related disasters such as landslides and debris flows were recorded, killing 15 people including victims caused by the sediment disaster triggered by the heavy rain in June 2016. In addition, 494 river embankment locations were damaged. (Source: Emergency Disaster Response Headquarters:

http://www.bousai.go.jp/updates/h280414jishin/pdf/h280414jishin_36.pdf,

and MLIT: http://www.mlit.go.jp/river/sabo/jirei/h28dosha/160914_gaiyou_sokuhou.pdf)

3. Economic Losses

The direct economic losses are estimated at 2.4-4.6 trillion yen (22.4-43.0 billion USD). It is a scale behind to the Great Hanshin-Awaji Earthquake in 1995.

Table 5 Direct Economic Losses Caused by Past Earthquakes in Japan

| Past Earthquake in Japan | Source | Direct Economic Losses | |
|-------------------------------------|--|------------------------|--------------|
| | | ¥ trillion | US\$ billion |
| 2016 Kumamoto Earthquakes | Cabinet Office analyst | 2.4-4.6 | 24-46 |
| 2011 Great East Japan Earthquake | Cabinet Office for Disaster Management | 16.9 | 169 |
| | Cabinet Office analyst | 16-25 | 16-25 |
| 2004 Chuetsu Earthquake | Niigata Prefecture | 1.7-3 | 17-30 |
| 1995 Great Hanshin-Awaji Earthquake | National Land Agency, Hyogo Prefecture | 9.6-9.9 | 96-99 |

Source: "Ministerial Conference Materials on Monthly Economic Report," 23 May 2016, Cabinet Office (<http://www5.cao.go.jp/keizai3/getsurei/2016/05kaigi.pdf>), Calculated as 1USD = 110 yen.

In addition, Kumamoto Prefecture estimated 3.8 trillion yen (34.5 billion USD) of the direct economic losses as of 14 September 2016.

4. Comparison with Recent Earthquake Disasters

A comparison of the earthquakes that occurred in Japan and ADRC member countries in recent years reveals that the magnitude of shaking in the 2016 Kumamoto Earthquakes is same as that experienced during the 1995 Great Hanshin-Awaji Earthquake, which was an inland active fault-type earthquake. However, it caused only 137 deaths because the epicenters were not in Kumamoto City, the prefectural capital and the second largest city on Kyushu Island. A comparison against the 2015 Nepal Earthquake and 2009 China Sichuan Earthquake, however, shows that while those earthquakes caused more casualties, the Kumamoto Earthquakes will result in much higher direct economic losses than were caused by the Nepal Earthquake.

Table 6 Direct Economic Losses Due to Recent Earthquakes in Asia

| | Magnitude (M) | Deaths (persons) | Direct Economic Losses (billion USD) |
|--|---------------|------------------|--------------------------------------|
| 2016 Kumamoto Earthquakes | 7.3 | 137 | 22.4-43.0 |
| 2015 Nepal Earthquake | 7.8 | 8,964 | 5 |
| 2011 Great East Japan Earthquake | 9.0 | 19,846 | 145-227 |
| 2009 China Sichuan Earthquake | 8.0 | 87,476 | 85 |
| 2004 Sumatra Earthquake and Indian Ocean Tsunami | 9.1 | 226,408 | 9.3 |
| 1995 Great Hanshin-Awaji Earthquake | 7.3 | 6,434 | 87-90 |

Source: Cabinet Office, EM-DAT, Calculated as 1USD = 110 yen.