

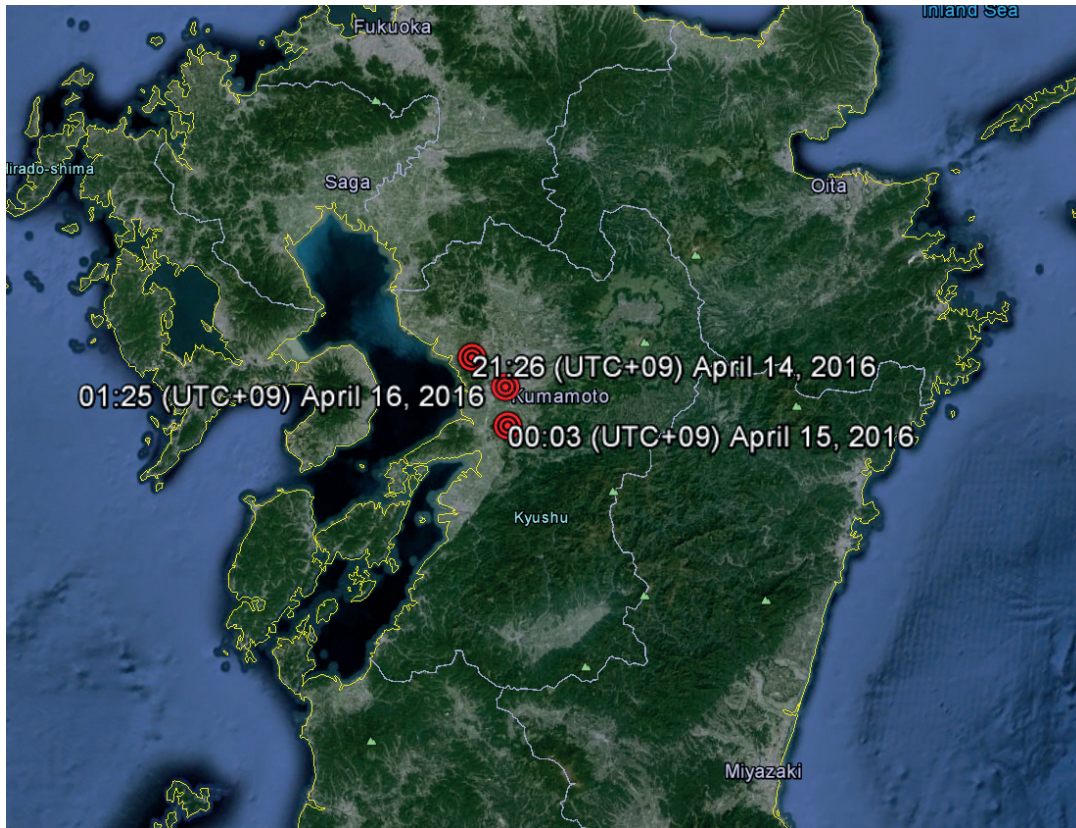


May 2016

KUMAMOTO EARTHQUAKE

In April of 2016, at mid-month, the world was once again reminded of the potential power of seismic activity by a series of earthquakes that hit Kumamoto prefecture on the southernmost island of Japan, as well as by the large shake that occurred half way around the world in Ecuador. In this briefing we summarize the basic facts regarding the 2016 Kumamoto Earthquake, including a description of the event itself and the basic seismic background of the area. We also outline the major earthquake coverages provided by Japanese insurers, report on possible loss amounts and list some of the major affected facilities.

F-1 | EVENTS OF MOMENT MAGNITUDE 6.0 AND LARGER



Source: Guy Carpenter

EVENT DESCRIPTION

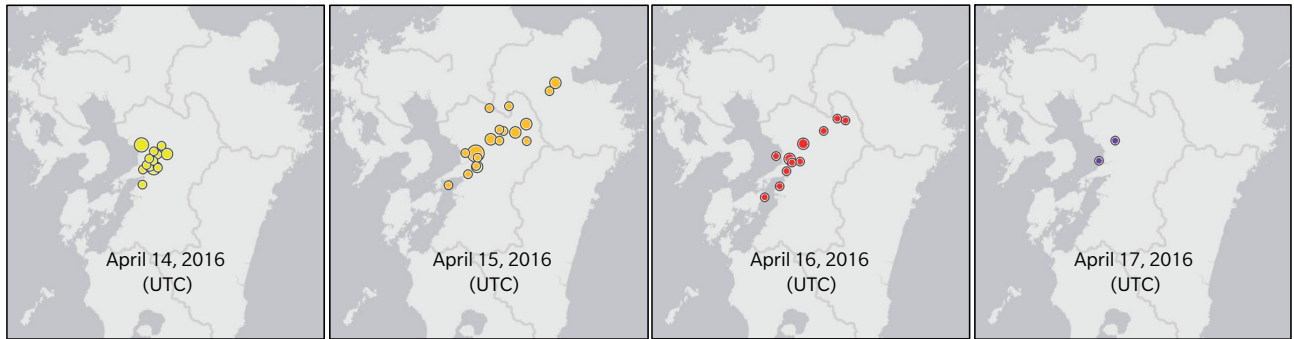
On April 14, 2016 at 9:26 p.m., local time, a moment magnitude 6.2 earthquake occurred approximately 12 kilometers (7.5 miles) west-northwest of Kumamoto city, which is situated in Kyushu, the southernmost main island of Japan. Two hours and 37 minutes later, a moment magnitude 6.0 earthquake occurred approximately 10 kilometers (6.2 miles) south of Kumamoto city.

On April 16 at 1:25 a.m., local time, 28 hours after the first foreshock, an event of moment magnitude 7.0 occurred approximately one kilometer (0.62 miles) west-southwest of Kumamoto city¹. The events were shallow earthquakes with reported depth of 10 kilometers (6.2 miles), according to the U.S. Geological Survey (USGS). The shallow depth of these events indicated that they occurred on crustal faults, the USGS said.

There were a series of foreshocks and aftershocks, shown in maps below, for the four day period that began with the first event of April 14.

¹ The source of the moment magnitudes are the USGS.

F-2 | EARTHQUAKE SHOCKS FROM APRIL 14TH THROUGH APRIL 17TH, UTC



Source: Guy Carpenter

T-1 | EARTHQUAKE EVENTS IN JAPAN STANDARD TIME

| UTC+09 | | Moment Magnitude | Depth in kilometers | Epicenter | |
|--------|-------|------------------|---------------------|-----------|-----------|
| Date | Time | | | Latitude | Longitude |
| Apr-14 | 21:26 | 6.2 | 10.0 | 32.849 | 130.635 |
| Apr-14 | 21:42 | 4.8 | 10.0 | 32.578 | 130.636 |
| Apr-14 | 22:07 | 5.4 | 10.0 | 32.788 | 130.835 |
| Apr-14 | 22:22 | 4.8 | 10.0 | 32.683 | 130.646 |
| Apr-14 | 22:38 | 4.8 | 10.0 | 32.685 | 130.711 |
| Apr-14 | 22:43 | 4.5 | 10.0 | 32.704 | 130.696 |
| Apr-14 | 23:28 | 4.5 | 10.0 | 32.785 | 130.745 |
| Apr-14 | 23:29 | 4.6 | 10.0 | 32.752 | 130.726 |
| Apr-14 | 23:43 | 4.9 | 10.0 | 32.783 | 130.758 |
| Apr-15 | 00:03 | 6.0 | 6.0 | 32.693 | 130.732 |
| Apr-15 | 00:06 | 5.3 | 10.0 | 32.707 | 130.701 |
| Apr-15 | 00:34 | 4.7 | 10.0 | 32.698 | 130.759 |
| Apr-15 | 00:50 | 4.5 | 10.0 | 32.742 | 130.727 |
| Apr-15 | 01:53 | 4.6 | 11.8 | 32.696 | 130.767 |
| Apr-15 | 02:14 | 4.5 | 10.0 | 32.713 | 130.671 |
| Apr-15 | 05:10 | 4.7 | 10.0 | 32.754 | 130.694 |
| Apr-15 | 07:29 | 4.6 | 10.0 | 32.843 | 130.791 |
| Apr-15 | 07:46 | 4.5 | 10.0 | 32.804 | 130.729 |
| Apr-16 | 01:25 | 7.0 | 10.0 | 32.782 | 130.726 |

| UTC+09 | | Moment Magnitude | Depth in kilometers | Epicenter | |
|--------|-------|---------------------|------------------------|-----------|-----------|
| Date | Time | | | Latitude | Longitude |
| Apr-16 | 01:44 | 5.3 | 10.0 | 32.695 | 130.735 |
| Apr-16 | 01:45 | 5.7 | 10.0 | 32.881 | 130.846 |
| Apr-16 | 02:04 | 4.6 | 11.7 | 32.757 | 130.742 |
| Apr-16 | 02:49 | 4.5 | 12.2 | 33.203 | 131.321 |
| Apr-16 | 03:03 | 5.4 | 4.9 | 32.926 | 131.043 |
| Apr-16 | 03:16 | 4.6 | 18.6 | 33.086 | 130.836 |
| Apr-16 | 03:20 | 4.5 | 19.4 | 33.101 | 130.997 |
| Apr-16 | 03:26 | 4.5 | 10.0 | 32.870 | 130.918 |
| Apr-16 | 03:55 | 5.5 | 13.8 | 32.980 | 131.136 |
| Apr-16 | 04:18 | 4.4 | 10.6 | 32.937 | 130.950 |
| Apr-16 | 04:51 | 4.7 | 3.4 | 32.698 | 130.734 |
| Apr-16 | 05:34 | 4.5 | 10.0 | 32.569 | 130.509 |
| Apr-16 | 06:31 | 4.3 | 11.0 | 32.867 | 131.137 |
| Apr-16 | 06:40 | 4.5 | 10.0 | 32.945 | 130.917 |
| Apr-16 | 07:11 | 5.1 | 10.0 | 33.256 | 131.370 |
| Apr-16 | 07:23 | 4.6 | 10.0 | 32.754 | 130.744 |
| Apr-16 | 07:42 | 4.1 | 10.0 | 32.788 | 130.645 |
| Apr-16 | 08:20 | 4.5 | 10.0 | 32.645 | 130.667 |
| Apr-16 | 09:16 | 4.3 | 10.0 | 32.559 | 130.583 |
| Apr-16 | 09:48 | 5.2 | 9.1 | 32.848 | 130.777 |
| Apr-16 | 10:38 | 4.3 | 10.0 | 32.486 | 130.465 |
| Apr-16 | 11:02 | 4.9 | 10.0 | 32.729 | 130.670 |
| Apr-16 | 14:03 | 4.6 | 10.7 | 33.003 | 131.118 |
| Apr-16 | 14:27 | 4.6 | 1.3 | 32.660 | 130.639 |
| Apr-16 | 16:02 | 5.3 | 16.2 | 32.747 | 130.668 |
| Apr-16 | 17:40 | 4.6 | 3.3 | 32.766 | 130.555 |
| Apr-16 | 21:05 | 4.6 | 12.7 | 32.728 | 130.750 |
| Apr-17 | 00:14 | 4.7 | 10.0 | 32.933 | 130.941 |
| Apr-17 | 03:30 | 4.3 | 16.0 | 33.016 | 131.050 |
| Apr-17 | 04:46 | 4.6 | 10.0 | 32.725 | 130.680 |
| Apr-17 | 19:23 | 4.7 | 5.1 | 32.733 | 130.564 |
| Apr-18 | 08:35 | 4.6 | 10.0 | 32.867 | 130.695 |
| Apr-18 | 20:42 | 5.3 | 10.7 | 33.013 | 131.092 |
| Apr-19 | 06:20 | 4.3 | 10.0 | 33.014 | 131.003 |
| Apr-19 | 17:52 | 5.1 | 3.2 | 32.512 | 130.567 |
| Apr-19 | 20:47 | 4.8 | 10.0 | 32.600 | 130.542 |
| Apr-20 | 03:38 | 4.1 | 5.0 | 32.480 | 130.656 |
| Apr-21 | 05:16 | 4.5 | 8.0 | 33.250 | 131.433 |

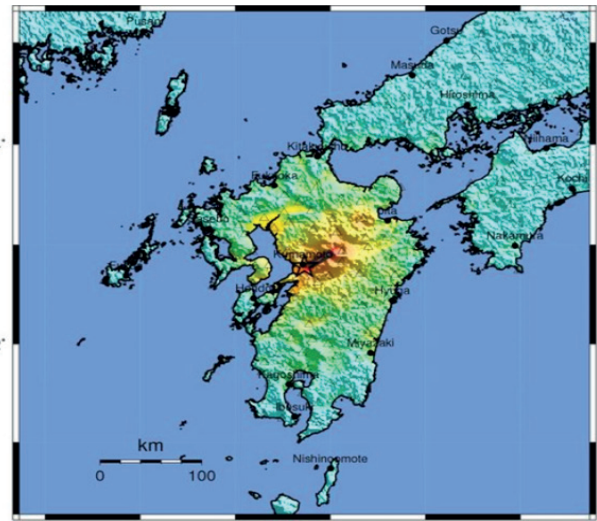
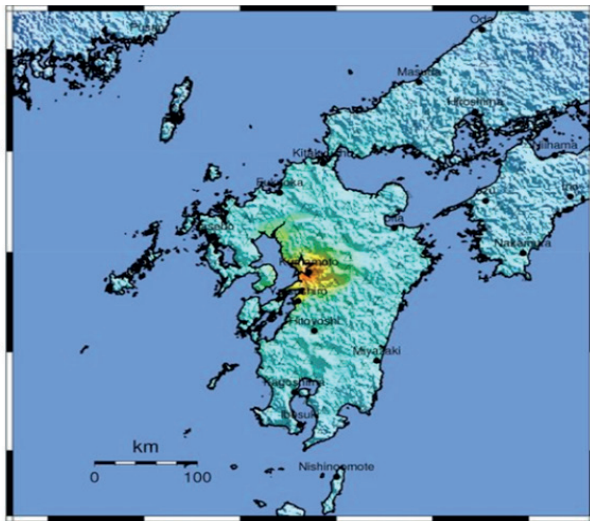
Source: USGS

The Japan Meteorological Agency (JMA) reported the first and second earthquake to be of magnitudes Mj 6.5 and Mj 7.3 (Mj is the local magnitude defined and calculated by the JMA) with depths of 11 kilometers (6.8 miles) and 12 kilometers (7.5 miles), respectively. The JMA named the sequence of earthquakes “The 2016 Kumamoto Earthquake”².

F-3 | EARTHQUAKE INTENSITY BY LOCATION USING MODIFIED MERCALLI INTENSITY

April 14, 2016 21:26:36 (UTC+09) Magnitude 6.2
32.849oN 130.635oE Depth 10 kilometers

April 16, 2016 01:25:06 (UTC+09) Magnitude 7.0
32.782oN 130.726oE Depth 10 kilometers



Source: USGS

T-2 | MODIFIED MERCALLI INTENSITY SCALE AND THE POPULATION BY OBSERVED INTENSITY

| Instrumental Intensity | | I | II-III | IV | V | VI | VII | VIII | IX | X+ |
|--|-----------------------|----------|---------|---------|------------|-----------|-------------|------------|------------|------------|
| Perceived Shaking | | Not felt | Weak | Light | Moderate | Strong | Very Strong | Severe | Violent | Extreme |
| Peak Accelerage (%g) | | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| Peak Velocity (cm/s) | | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| Potential Damage | Resistant Structures | None | None | None | Very light | Light | Moderate | Mod./Heavy | Heavy | Very Heavy |
| | Vulnerable Structures | None | None | None | Light | Moderate | Mod./Heavy | Heavy | Very Heavy | Very Heavy |
| Population Exposed in Damage Prone Areas | | | - | | 8,510,000 | 1,757,000 | 592,000 | 892,000 | 0 | 0 |

Source: Guy Carpenter

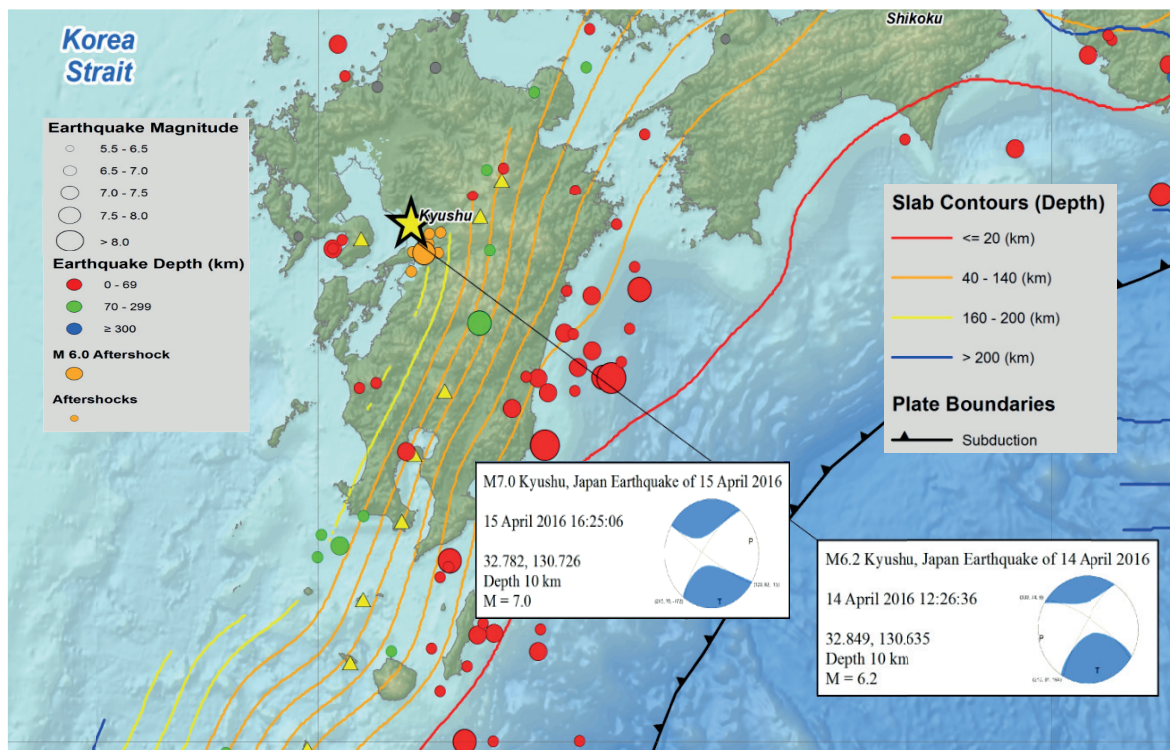
The USGS estimates that 892,000 people were exposed to the severe shaking of the second earthquake.

² Japan Meteorological Agency: Report for Kumamoto earthquake (No.4)

SEISMIC RISK IN THE KYUSHU AREA

The Ryukyu Trench is situated southeast of Kyushu where the Philippine Sea plate begins its subduction beneath Japan. While earthquakes have occurred several hundred kilometers northwest of the Ryukyu Trench, most earthquakes are at significant depths along this subduction zone. Thirteen magnitude 5-plus earthquakes have occurred at shallow depths of less than 50 kilometers (31.1 miles) within 100 kilometers (62.1 miles) of the Kumamoto earthquake over the past century, according to the USGS. In addition to the two events in April, a shallow magnitude 6.6 earthquake occurred in 2005 off the north coast of Kyushu. Two other events occurred in 1975 that were of magnitude 5.8 and 6.1 at distances of 40 kilometers (24.9 miles) and 65 kilometers (40.4 miles) to the northwest. The graphic below from the USGS illustrates the depth of the Ryukyu Trench at 20 kilometer (12.4 miles) increments in orange. The depth of the trench beneath Kumamoto city is roughly 140 plus kilometers (87.0 miles).

F-4 | DEPTH OF THE RYUKYU TRENCH AND DEPTH OF HISTORICAL EARTHQUAKES



Source: USGS

EARTHQUAKE COVERAGE IN JAPAN

Japan is known for its earthquake potential; and like many other earthquake-prone countries, the government participates in insuring earthquake risk. For houses and residential buildings there are two major sources of earthquake insurance. One is via commercial non-life insurance companies with support from the government and the other is via cooperative insurers. For all buildings and man-made structures other than houses and residential buildings, earthquake insurance is available from commercial non-life insurance companies, albeit on a strictly controlled basis.

Earthquake coverage can typically be included on marine hull, ocean cargo and aviation hull risks. It is typically excluded for motor vehicles and personal accident insurance, though can be obtained.

Earthquake coverage includes earthquake, fire following, tsunami and volcanic eruption.

RESIDENTIAL EARTHQUAKE COVERAGE

Residential earthquake insurance provided by non-life insurers is strictly governed by a special law concerning earthquake insurance that was enacted in 1966 following the Niigata earthquake of 1964. Earthquake insurance is provided for an additional premium as an endorsement to the fire insurance policy, which covers buildings in residential use. The amount insured under the earthquake policy must be between 30 percent and 50 percent of the amount insured under the associated fire policy, with a maximum amount of earthquake insurance of JPY50 million (USD467,000) for buildings and JPY10 million (USD93,000) for contents.

Earthquake insurance on residential risks written by commercial non-life insurance companies is 100 percent ceded to the Japan Earthquake Reinsurance Company, Ltd (JER). The JER in turn retrocedes most of this risk to the Japanese government via an excess of loss structure, with a small portion retroceded back to the non-life insurance companies and reinsurer Toa Re. The companies must retain 100 percent of the retrocession. As of April 1, 2014, the program's limit was JPY7,000 billion (USD 65.421 billion) with the government assuming JPY6,738.6 billion (USD62.978 billion) in limit (96.3 percent), the JER retaining JPY224.7 billion (USD2.100 billion) (3.2 percent) and the non-life insurance companies retaining JPY36.7 billion (USD0.343 billion) (0.5 percent). Starting April 1, 2016, the program's limit was increased to JPY11,300 billion (USD 105.607 billion) with the government retaining JPY10,990.2 billion (USD102.712 billion) in limit (97.3 percent)³.

As of 2014, the countrywide take-up rate with the JER was approximately 29.4 percent with the take-up in Kumamoto Prefecture at 28.9 percent.

T-3 | NUMBER OF DWELLINGS AND THE PERCENTAGE INSURED WITH THE JER

| Prefecture | Zone | Number of Homes | Number of Homes Insured with the JER | Takeup Rate |
|-----------------|-----------|-------------------|--------------------------------------|--------------|
| Hokkaido | 1 | 2,727,000 | 619,000 | 22.7% |
| Akita | 2 | 425,000 | 82,000 | 19.3% |
| Aomori | 2 | 585,000 | 114,000 | 19.5% |
| Niigata | 2 | 874,000 | 179,000 | 20.5% |
| Yamagata | 2 | 407,000 | 79,000 | 19.4% |
| Fukushima | 3 | 760,000 | 209,000 | 27.5% |
| Iwate | 3 | 515,000 | 108,000 | 21.0% |
| Miyagi | 3 | 950,000 | 493,000 | 51.9% |
| Gunma | 4 | 808,000 | 159,000 | 19.7% |
| Ibaraki | 4 | 1,187,000 | 328,000 | 27.6% |
| Saitama | 4 | 3,085,000 | 948,000 | 30.7% |
| Tochigi | 4 | 793,000 | 206,000 | 26.0% |
| Chiba | 5 | 2,704,000 | 897,000 | 33.2% |
| Kanagawa | 5 | 4,114,000 | 1,418,000 | 34.5% |
| Tokyo | 5 | 6,699,000 | 2,446,000 | 36.5% |
| Aichi | 6 | 3,096,000 | 1,261,000 | 40.7% |
| Gifu | 6 | 792,000 | 266,000 | 33.6% |
| Mie | 6 | 768,000 | 213,000 | 27.7% |
| Nagano | 6 | 846,000 | 156,000 | 18.4% |
| Shizuoka | 6 | 1,518,000 | 453,000 | 29.8% |
| Yamanashi | 6 | 350,000 | 103,000 | 29.4% |
| Fukui | 7 | 284,000 | 70,000 | 24.6% |
| Ishikawa | 7 | 466,000 | 111,000 | 23.8% |
| Toyama | 7 | 405,000 | 81,000 | 20.0% |
| Hyogo | 8 | 2,460,000 | 616,000 | 25.0% |
| Kyoto | 8 | 1,176,000 | 325,000 | 27.6% |
| Nara | 8 | 577,000 | 158,000 | 27.4% |
| Osaka | 8 | 4,117,000 | 1,258,000 | 30.6% |
| Shiga | 8 | 548,000 | 142,000 | 25.9% |
| Wakayama | 8 | 437,000 | 105,000 | 24.0% |
| Hiroshima | 9 | 1,273,000 | 364,000 | 28.6% |
| Okayama | 9 | 817,000 | 172,000 | 21.1% |
| Shimane | 9 | 284,000 | 42,000 | 14.8% |
| Tottori | 9 | 232,000 | 51,000 | 22.0% |
| Yamaguchi | 9 | 656,000 | 149,000 | 22.7% |
| Ehime | 10 | 645,000 | 148,000 | 22.9% |
| Kagawa | 10 | 427,000 | 126,000 | 29.5% |
| Kochi | 10 | 353,000 | 87,000 | 24.6% |
| Tokushima | 10 | 329,000 | 89,000 | 27.1% |
| Fukuoka | 11 | 2,296,000 | 751,000 | 32.7% |
| Kagoshima | 11 | 802,000 | 194,000 | 24.2% |
| Kumamoto | 11 | 757,000 | 219,000 | 28.9% |
| Miyazaki | 11 | 515,000 | 123,000 | 23.9% |
| Nagasaki | 11 | 626,000 | 86,000 | 13.7% |
| Oita | 11 | 525,000 | 118,000 | 22.5% |
| Saga | 11 | 321,000 | 59,000 | 18.4% |
| Okinawa | 12 | 600,000 | 86,000 | 14.3% |
| Total | | 55,931,000 | 16,467,000 | 29.4% |

Source: http://www.nihonjishin.co.jp/disclosure/2015/a_05.pdf

3 Source: https://www.mof.go.jp/english/financial_system/earthquake_insurance/outline_of_earthquake_insurance.html

The other source of residential earthquake insurance is through a limited number of cooperative insurers. As opposed to residential earthquake insurance under the government's program, cooperative earthquake insurance is entirely run and managed by each individual cooperative insurer that writes the class, with no governmental support. The original policy terms tend to be somewhat similar in basic design to those of the government's program backed policies, but reinsurance arrangements are entirely at the discretion of the individual cooperatives. Almost all the cooperatives writing this class purchase non-proportional reinsurance from the international reinsurance market and, in certain cases, also access the capital markets for protection via catastrophe bond issuance.

In the cooperative sector, Zenkyoren, the agricultural mutual, is by far the largest. The number of policies Zenkyoren had in force in 2014 was 10,529 million⁴, which is 64 percent of the size of the JER in terms of number of policies. The next largest cooperative is Zenrosai, which had 2.1 million natural peril policies in force in 2014⁵.

COMMERCIAL AND INDUSTRIAL EARTHQUAKE COVERAGE

For all commercial and industrial risks, earthquake insurance is only available from commercial non-life insurance companies. The policy terms, including original rates, are set by the individual insurance companies or determined following negotiations between the insured and the insurer(s). Because of the high loss potential, insurance companies strictly control their earthquake aggregate exposure by sub limiting the potential payments. It is not unusual for these sublimits to be less than 5 percent of the fire sum insured for very large corporate insureds holding a large amount of property across Japan. Also, non-life insurance companies typically provide only very limited coverage for business interruption.

EARTHQUAKE FIRE EXPENSE INSURANCE (EFEI)

Earthquake Fire Expense Insurance (EFEI) is an expense insurance coverage specific to Japan that is designed to pay additional expenses caused by fire following an earthquake. For non-life insurers, EFEI is included as a standard feature in their normal fire insurance policies, for both residential and non-residential insureds. EFEI does not fall under the government's JER program.

POTENTIAL LOSSES FROM THE KUMAMOTO EARTHQUAKE

The catastrophe modeling firm RMS estimated the economic loss for property risks to be between USD2.5 billion and USD3.5 billion⁶. This estimate includes only residential, commercial, and industrial property and contents. Catastrophe modeling firm AIR estimated the insured loss to be between USD1.7 billion and USD2.9 billion for property risks⁷. Both catastrophe modeling firms' estimates exclude infrastructure, business interruption and contingent business interruption.

The Japan Fire and Disaster Management Agency (FDMA) released its forty-fourth Kumamoto Earthquake Bulletin on April 28. The bulletin reports 65 fatalities, 332 severe injuries and 1,161 minor injuries. The bulletin also reports residential building damage of:

- Total damage to 2,111 buildings
- Half damage to 2,414 buildings
- Partial damage to 9,592 buildings

4 Source: <http://www.ja-kyosai.or.jp/ebook/2015annual/index.html#page=15>

5 Source: <https://www.zenrosai.coop/english/>

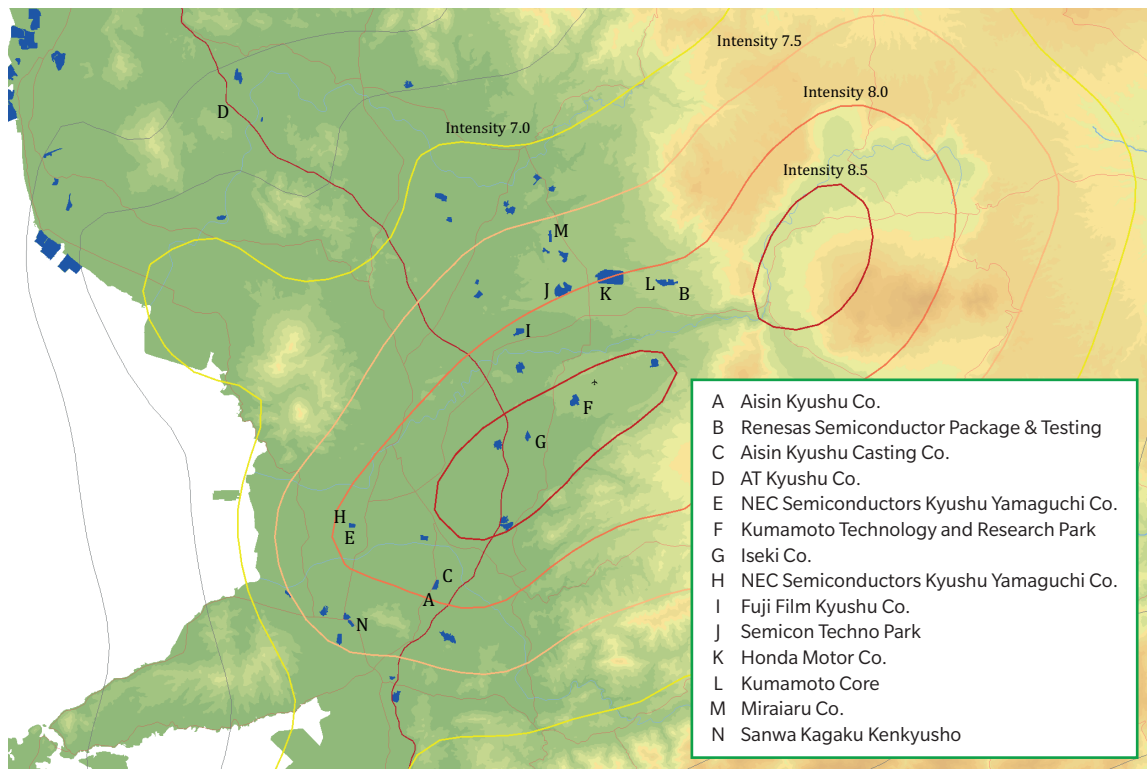
6 Source: RMS Own Event Response webpage update 27 and Asia Insurance Review, <http://www.asiainsurancereview.com/News/View-NewsLetter-Article?id=35722&Type=eDaily>

7 Source: <http://www.air-worldwide.com/Facet-Search/Search-Results/>

For non-residential buildings, FDMA reported damage to 94 public buildings and 351 other buildings. They also reported 16 fires as a result of the earthquakes.

There is a potential for business interruption and contingent business interruption losses to companies relying on supplies from factories in the Kumamoto region. There are a number of industrial parks in the area that are shown in blue in the map below and some of the companies in these parks are highlighted in the table insert.

F-5 | INDUSTRIAL PARKS AND CORPORATIONS IN KUMATOMO PREFECTURE



Source: Guy Carpenter

Toyota Motor Corporation expects to lose 80,000 units of production after shutting down nearly all of its assembly plants in Japan. The shutdowns occurred after disruption to two of its suppliers, Aisin Seiki, which produces automotive components and Renesas Electronics, a manufacturer of automotive microchips⁸. Aisin Seiki said production at two plants that make engine and auto parts, semiconductors and other components have been stopped since April 14. Renesas’s plant was also shut down⁹.

Toyota was not the only automaker affected. Nissan experienced a brief slowdown, Honda suspended a motorcycle plant in the region and Mitsubishi closed a production line due to a parts shortage¹⁰.

General Motors temporarily closed four North American assembly plants because of supply chain disruptions. The assembly plants shutdowns were in Spring Hill, Tennessee; Lordstown, Ohio; Fairfax, Kansas and Oshawa, Ontario¹¹.

8 Source: <http://www.autonews.com/article/20160424/OEM/160429922/toyota-estimates-loss-in-output-from-japan-quakes-at-80000-vehicles>

9 Source: <http://www.bloomberg.com/news/articles/2016-04-18/toyota-seen-losing-277-million-from-japan-earthquake-stoppages>

10 Ibid

11 Source: <http://www.autonews.com/article/20160422/OEM01/160429944/gm-to-idle-4-n.a.-plants-for-2-weeks-after-japan-quakes-disrupt>

Other companies in the area reporting suspended operations according to Newswitch¹²:

- Fuji Seiko (Precision): Operations at their Kumamoto factory in Otsu-town were suspended, but the supply of their products, such as cutting tools, will be maintained by shifting production to other factories.
- Chuo Katan Kogyo: Operations at their Kumamoto factory in Otsu-town, which cuts aluminum and other mold products for automobiles, were suspended.
- Koshi Tech: Operations at their Kumamoto factory, which manufactures components and parts for motorbikes, automobiles and general-purpose engines, were suspended.
- Honda: Operations at their Kumamoto factory in Otsu-town were suspended but Honda's product supply was maintained by shifting production to other Honda factories.
- Bridgestone: Operations at their Kumamoto factory in Tamana-city that produce rubber crawlers and high-pressure hoses were suspended.
- NOK: Operations at their Kumamoto factory in Aso-city, which manufactures O-rings, were suspended due to power shortages.
- Toyota Motor Kyushu: Both the Kanda factory, which manufactures engines, and the Kokura factory, which manufactures the components for hybrid cars, suspended operations.
- NIFCO: The factory that manufactures resin interior parts for automobile cabins and certain components for fuel systems suspended operations due to property damage.
- Alfresa Holdings: Shipping of its pharmaceutical supplies was suspended from its Kyushu logistics Centre.
- Kumamoto Milling: Production at the Kumamoto factory and the Koshi rice mill was suspended.
- Fuji Film Kyushu: Production at their Kumamoto factory was suspended.

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¹² Source: <https://newswitch.jp/p/4395>

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