(Outline 2)

Outline of the National Seismic Hazard Maps for Japan (2020)

English version
Translated in January 2026
Secretariat of the Headquarters for Earthquake Research Promotion

This document is an English translation
of the "*全国地震動予測地図2020年版の概要*" published in March 2021.

Major changes from the 2018 edition to the 2020 edition (1)

I. Probabilistic Seismic Hazard Maps

(1) Reflection of long-term evaluation and tsunami assessment

Consideration of further variability in the source regions for large interplate earthquakes along the Japan Trench and the Nankai Trough, based on "Long-term evaluation of seismic activity along the Japan Trench (2019)" and "Probabilistic hazard assessment of tsunami due to large earthquakes along the Nankai Trough (2020)".

(2) Improvement of the models for earthquakes with uncertain source areas, magnitudes, and recurrence intervals (earthquakes for unspecified source faults)

1) Improvement of the method for calculating the frequency of earthquake occurrence, considering seismic activities after the 2011 off the Pacific Coast of Tohoku Earthquake

- Extending the period of the earthquake catalog used to calculate the earthquake occurrence frequency to after the 2011 off the Pacific Coast of Tohoku Earthquake
- Considering the uncertainty of frequency of earthquake occurrence by combining the conventional method of excluding aftershocks and the alternative method of including all earthquakes in the catalog

2) Review of the areas for calculating the frequency of earthquake occurrence for unspecified source faults

Adding or modifying areas after considering recent earthquakes that do not sufficiently correspond to seismic activity models (November 2016 earthquake offshore of Fukushima Prefecture, the 2018 Hokkaido Eastern Iburi Earthquake) or long-term evaluations.

(3) Improvement of the Shallow Soil Layers model used to calculate the site amplification factors

- Reflection of the Combined Shallow and Deep Layers Model (2021 edition) created by considering boring data and geological and geophysical information for the Kanto region
- Reflection of reviews of geomorphologic classifications that consider new findings from Wakamatsu and Matsuoka (2020) for areas outside the Kanto region

(4) Change of the evaluation reference date of probabilities of earthquake occurrence: Jan. 1, 2018 ⇒ Jan. 1, 2020

[Seismic hazard maps for reference date of Jan. 1, 2021-2024 are available at the Japan Seismic Hazard Information Station (J-SHIS)]

Major changes from the 2018 edition to the 2020 edition (2)

II. Seismic Hazard Maps for Specified Seismic Source Faults (Seismic Hazard Maps for Scenario Earthquakes)

(1) Improvement of the seismic velocity structure models of soil layers

- Kanto region: changing the depth of engineering bedrock for the detailed method and reflecting the Shallow Soil Layers model based on the Combined Shallow and Deep Layers Model (2021)
- Areas outside the Kanto region: reflecting the review of geomorphologic classification that considers new findings from Wakamatsu and Matsuoka (2020)

III. Utilization of the National Seismic Hazard Maps for Japan

(1) Revision of the color scheme of the seismic hazard maps (see page 7)

- Revising the color scheme of the probability distribution map and the seismic intensity distribution map based on the unified policy of the color scheme of the publications of the Headquarters for Earthquake Research Promotion

(2) Providing Seismic Hazard Maps at regional and prefectural levels

- Posting the seismic hazard map with an expanded display range for each region such as Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku/Shikoku, and Kyushu/Okinawa, and each prefecture (or subprefecture for Hokkaido) with the aim of improving users' convenience

(3) Reorganizing earthquake classification into "shallow crustal earthquakes" and "subduction-zone earthquakes"

- Integrating the conventionally used earthquake category I (subduction-zone earthquakes with specified source faults) and category II (subduction-zone earthquakes for unspecified source faults) as "subduction-zone earthquakes" and changing the name of category III to "shallow crustal earthquakes" based on the long-term evaluation of the subduction-zone earthquakes that considers the diversity of source areas

(4) Updating the Guide and Commentary

- Providing the basic operation procedure of the Japan Seismic Hazard Information Station (J-SHIS) to expand utilization
- Updating based on revisions of the color schemes of the seismic hazard map or reorganization of earthquake classification, etc.

Two types of seismic hazard maps included in map edition (1)

Probabilistic Seismic Hazard Maps (2020)

Probabilistic Seismic Hazard Maps show the distributions of the possible ground shaking intensity or the probability of a specific ground shaking intensity, both of which are estimated from the location, magnitude, and probability of all earthquakes conceivable at this moment. The distribution of either of the two parameter (ground shaking intensity or exceedance probability) for fixed period (ex. 30 or 50 years) is calculated by fixing the other parameter.

The probabilities are high in south-eastern Hokkaido, Sendai Plain, Tokyo Metropolitan Area, the Pacific side of the Tokai-Shikoku region, and the area along the Itoigawa–Shizuoka Tectonic Line fault zone.

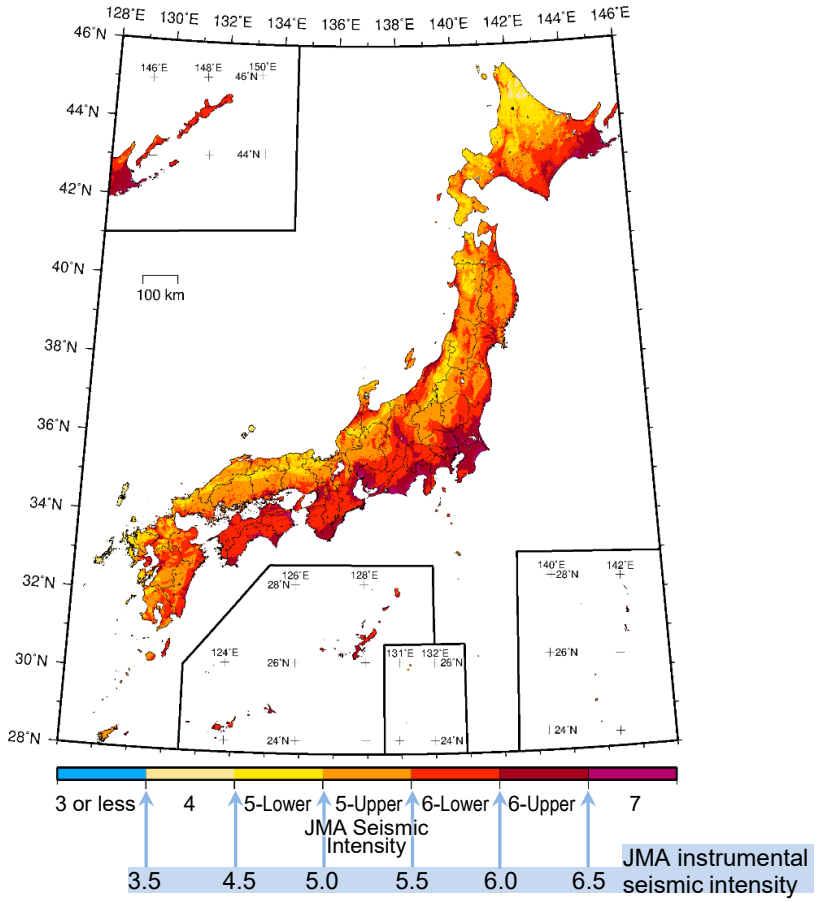


Fig. 1. Japan Meteorological Agency (JMA) seismic intensity for which the probability of ground motions equal to or greater than the values within the next 30 years is 3% (an example of a map showing the JMA seismic intensity with fixed period and probability).

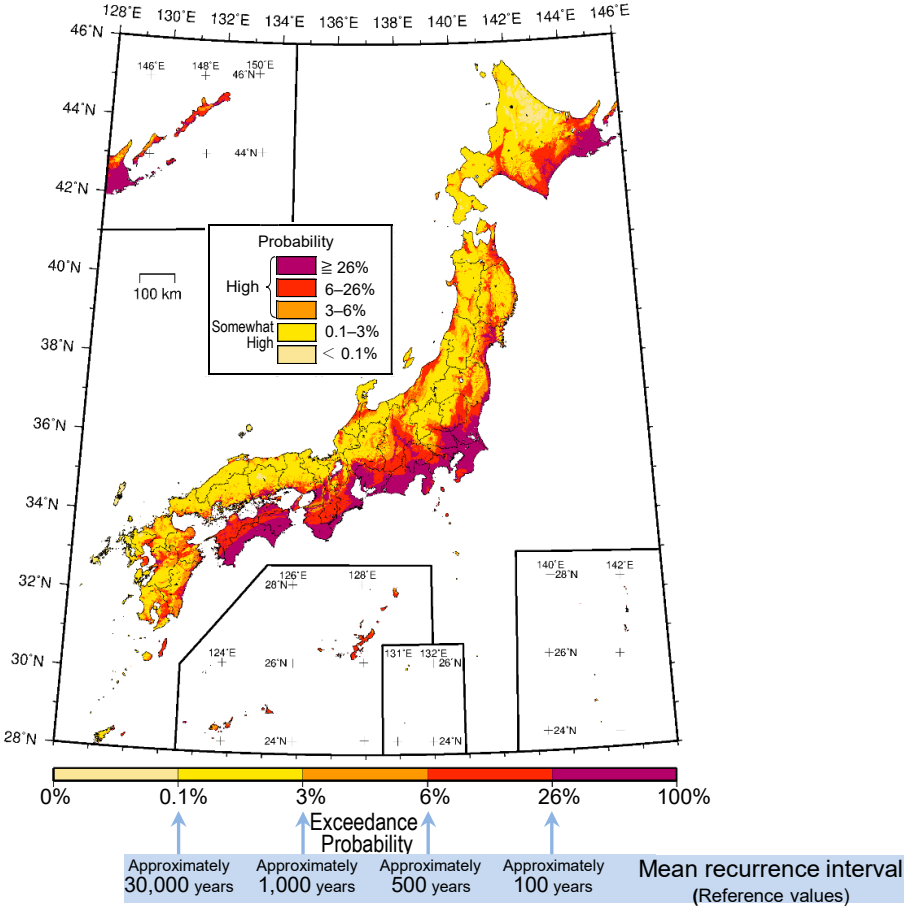


Fig. 2. Probability of ground shaking of JMA seismic intensity of 6-Lower or higher within the next 30 years (an example of a map showing the probability with fixed period and intensity).

* As for the exceedance probability of ground motion intensity for the next 30 years, the values of 0.1%, 3%, 6%, and 26% roughly correspond to occurrences once every 30,000, 1,000, 500, and 100 years, respectively.

Two types of seismic hazard maps included in map edition (2)

Seismic Hazard Maps for Specified Seismic Source Faults (Seismic Hazard Maps for Scenario Earthquakes) (2020)

A map showing the distribution of seismic intensity at each grid cell on the ground surface calculated for an earthquake expected along a specific source fault. This map can be used to identify, for example, the distribution of the population exposed to ground shaking with seismic intensities greater than a given value.

With improvements to the seismic velocity structure models in the 2020 edition, the seismic intensity distributions on the ground surface for the active faults were revised from those in the previous edition of the National Seismic Hazard Maps for Japan.

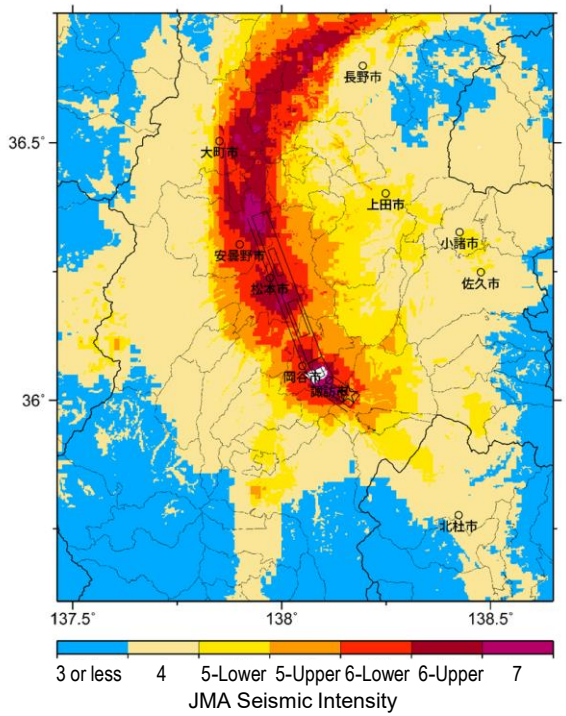


Fig. 3. Example of distribution of seismic intensities on the ground surface owing to an earthquake in the northern-central segment of the Itoigawa-Shizuoka Tectonic Line fault zone

The number at the upper right indicates the total population exposed to a specific seismic intensity within the map area

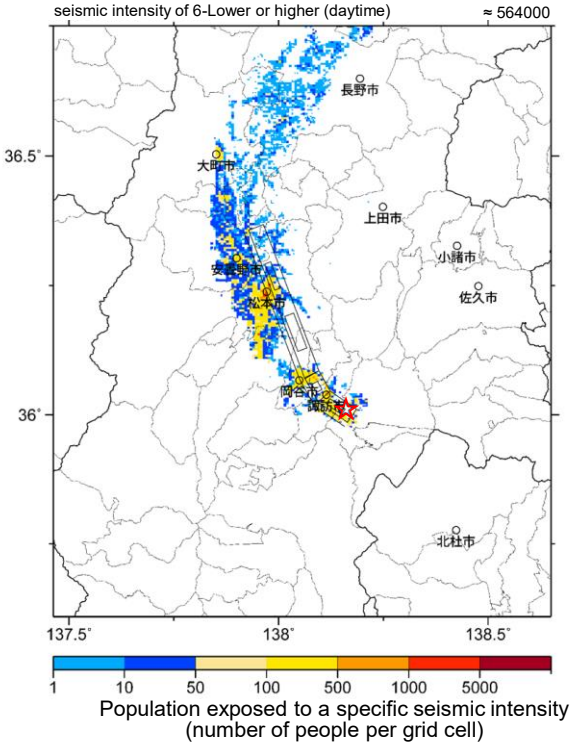
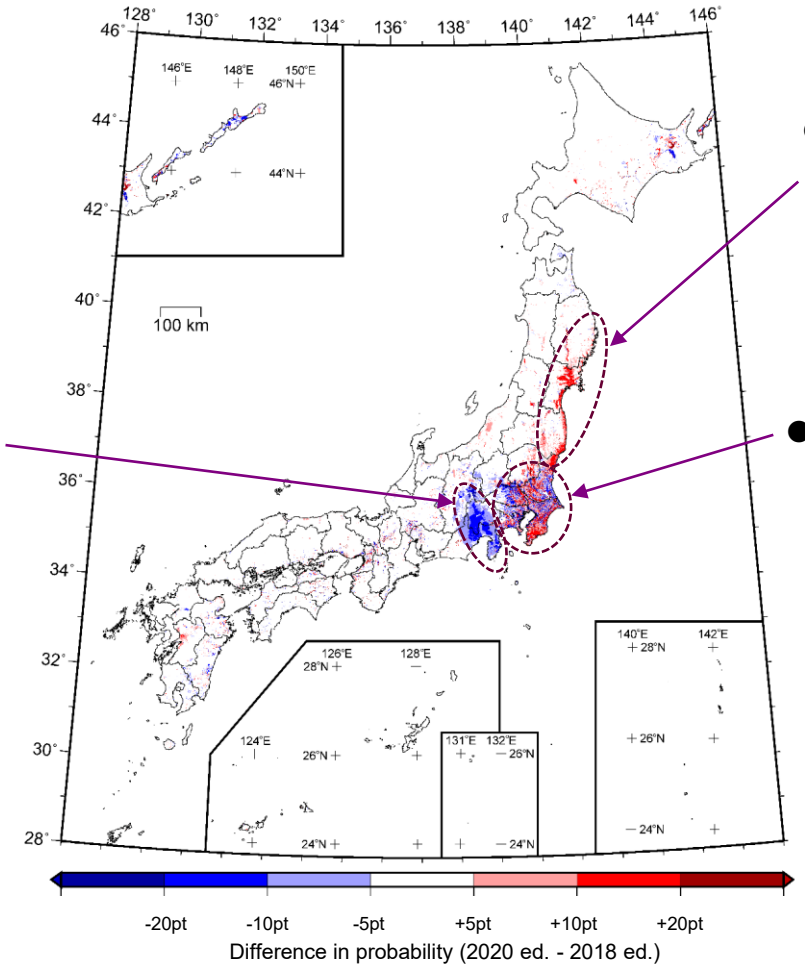


Fig. 4. Example of distribution of the population exposed to ground shaking with a seismic intensity of 6-Lower or higher owing to an earthquake occurring in the northern-central segment of the Itoigawa-Shizuoka Tectonic Line fault zone.

*Detailed calculation results not included in the published edition and details of various calculation scenarios are available at the Japan Seismic Hazard Information Station (J-SHIS: https://www.j-shis.bosai.go.jp/en/).

Main differences from the Probabilistic Seismic Hazard Maps (2018)

Compared with the 2018 edition, the maps of the "probability of ground shaking of JMA seismic intensity of 6-Lower or higher within the next 30 years" in the 2020 edition have the following main differences:



- The probability increased because the seismicity after the 2011 off the Pacific Coast of Tohoku Earthquake was taken into consideration.

- The probability decreased because the model has been changed to one considering the diversity of source areas of the "large interplate earthquakes occurring along the Nankai Trough".

- The probability increased or decreased by improving the shallow soil layers model used to calculate the amplification factors (the new Shallow Soil Layers model is a part of the Combined Shallow and Deep Layers Model newly constructed for the Kanto region).

*Nationwide (excluding Kanto region): The probability increased or decreased locally by improving the Shallow Soil Layers model used to calculate the amplification factors (the review of geomorphologic classifications).

Fig. 5. Changes in the probability of ground shaking of JMA seismic intensity of 6-Lower or higher within the next 30 years (average case/all earthquakes) (2020 edition - 2018 edition)

*Main differences from the 2018 edition are described in detail in “Drafting Guidelines & Calculation Results".

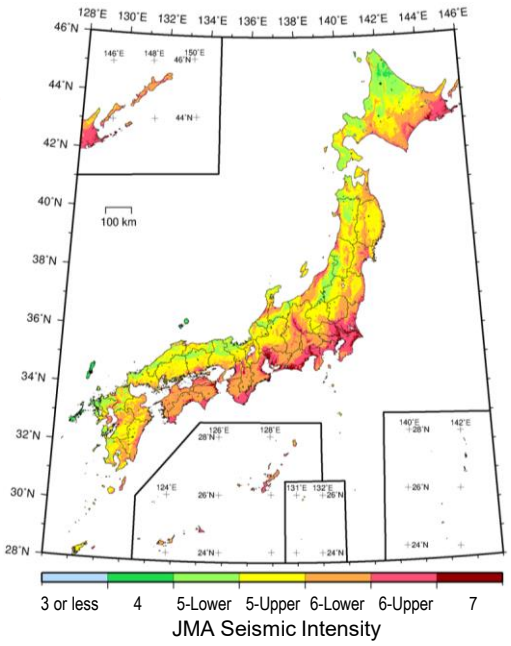
Revision of the color scheme of the seismic hazard map

The color scheme of the seismic hazard map was revised based on the color scheme of the publications of the Earthquake Headquarters, which was formulated by the Earthquake Headquarters Policy Committee after examining the domestic and international trends regarding color standards and color unification as well as the review of the color scheme accommodated to various types of color vision. A stage display was appropriately selected from the color scheme according to the drawing target for the figure showing the hazard level.

Risk / hazard	High ←							→ Low
Color scheme	Red-purple	Red	Scarlet	Orange	Yellow	Light yellow	Blue	Light blue	Light gray

Fig. 6. Scale shown in color scheme

Before color scheme change



After color scheme change

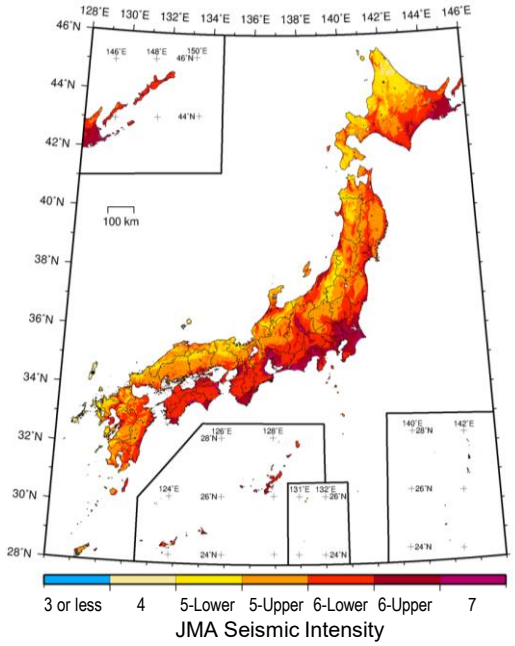


Fig. 7. Comparison example before and after changing color scheme of the seismic hazard map
(JMA seismic intensity for which the probability of ground motions equal to or greater than the values within the next 30 years is 3%)

*The color schemes of the “probability distribution map”, “site amplification factor distribution map”, and “distribution map of population exposed to seismic intensity" were also changed in addition to that for "seismic intensity distribution map“ shown as an example.

Composition of the National Seismic Hazard Maps for Japan (2020)

- Key points
- Outline

} Summary

- Let's look at national seismic hazard maps
- Guide & Commentary

} Commentary material for general users
Guide: basic commentary
Commentary: more detailed commentary

- Map edition

Table of contents

About this document
Probabilistic Seismic Hazard Maps
National Seismic Hazard Maps for Japan
Seismic Hazard Maps by region and prefecture (Available only in Japanese)
Seismic Hazard Maps for Specified Seismic Source Faults
(Seismic Hazard Maps for Scenario Earthquakes) (Available only in Japanese)

} Main parts

- Drafting Guidelines & Calculation Results (Available only in Japanese)

} Explanation of Drafting Guidelines and Calculation Results that were changed from the 2018 edition

* The Japan Seismic Hazard Information Station (J-SHIS) presents the seismicity model, seismic source model, and the seismic velocity structure model, which are required for the evaluation of the "seismic hazard map", in addition to the map. J-SHIS is operated by the National Research Institute for Earth Science and Disaster Prevention (https://www.j-shis.bosai.go.jp/en/). Detailed calculation results not included in the published edition and details of various calculation scenarios are also available there.

List of major seismic hazard maps in the 2020 edition

・Probabilistic Seismic Hazard Maps

The following maps, etc. are included (Map edition, p. 5–324):

● **Probability distribution**

Example: the probability of ground shaking of JMA seismic intensity of 6-Lower or higher within the next 30 years (average case, all earthquakes)

→Multiple maps with different seismic intensities are available.

● **Seismic intensity distribution**

Example: seismic intensity for 3% probability of exceedance occurring within the next 30 years (average case, all earthquakes)

→ Multiple maps with different periods and probabilities are available.

● **Long-term average seismic hazard map**

Example: long-term average seismic intensity distribution (equivalent to occurrence interval of 1,000 years)

→Multiple maps with different occurrence intervals are available.

● **Seismic hazard map by region and by prefecture**

→Enlarged maps for each region and prefecture are available.

(Available only in Japanese)

・Seismic Hazard Maps for Specified Seismic Source Faults

Re-evaluation results of the ground motion around active fault zones evaluated in the 2014–2018 editions are published (Map edition, p. 325-827). (Available only in Japanese)

○ Seismic intensity distribution (detailed method)

→ A seismic intensity distribution map on the ground surface for each rupture scenario are available.

○ Seismic intensity distribution (simple method)

→ A seismic intensity distribution map on the ground surface using the simple method are available.

○ Population exposed to a specific seismic intensity

→ A map of the population exposed to ground motion above a particular seismic intensity based on the seismic intensity distribution are available.

*The map selection and reading methods according to objective are provided in the Guide and Commentary.
*Details of various other calculation scenarios are available at the Japan Seismic Hazard Information Station (J-SHIS).

History to date and this announcement

Mar. 2005 **National Seismic Hazard Maps for Japan** released ➢ Evaluation revised every year and results announced since then

Jul. 2009 Significantly revised **National Seismic Hazard Maps for Japan** released

➢ Evaluation revised every year and results announced since then

Mar. 2011 **The 2011 off the Pacific Coast of Tohoku Earthquake occurred (Mar. 11)**

➢ Problems such as low-frequency large-scale earthquakes were indicated, and reviews initiated

Dec. 2012 Review on future seismic hazard evaluations ～Review results in 2011 and 2012～ released

- Report on results of reviewing problems for probabilistic seismic hazard evaluations
- Review of models mainly near the source area of the 2011 off the Pacific Coast of Tohoku Earthquake

Dec. 2013 Review on future seismic hazard evaluations ～Review results in 2013～ released

- Revision of the nationwide seismic activity model and the revision of probabilistic seismic hazard evaluations

Dec. 2014 **National Seismic Hazard Maps for Japan (2014)** released

- Reflection of new long-term evaluation results and summary of review results since 2011

Jun. 2016 **National Seismic Hazard Maps for Japan (2016)** released

- Reflection of new long-term evaluation results and updating of strong ground motion prediction "Recipe"

Apr. 2017 **National Seismic Hazard Maps for Japan (2017)** released

- Reflection of new long-term evaluation results and new seismic velocity structure model
- Updating of Guide and Commentary and strong ground motion prediction “Recipe”

Jun. 2018 **National Seismic Hazard Maps for Japan (2018)** released

- Reflection of new long-term evaluation results

Mar. 2021 **National Seismic Hazard Maps for Japan (2020)** released

- Reflection of new long-term evaluation/tsunami assessment, improved seismic velocity structure model
- Improvements in modeling earthquakes for unspecified source faults
- Change of map color scheme, posting of seismic hazard maps by region and prefecture
- Updating of Guide and Commentary

Effort needed for future improvement

- Updating of National Seismic Hazard Maps for Japan to reflect new knowledge
  - Reflection of long-term evaluation results
  - Improvements in the calculation conditions based on new knowledge and survey results
- Enhancement of the seismic hazard maps
  - Improvements in the seismic source fault model, enhancement of the seismic velocity structure model, and strong ground motion prediction method
  - Seismic hazard evaluation based on response spectrum of predicted ground motion
- Effective utilization by adding innovations to the seismic hazard maps
  - Improvements in the map expression method that reflect opinions/requests of users
- Enrichment of easy-to-understand explanations for users with various purposes
  - Further enrichment of Guide and Commentary

Points to keep in mind when looking at Seismic Hazard Maps for Japan

■ Points to keep in mind when looking at Seismic Hazard Maps

● "Low probability" does not always mean that it is safe

Japan is highly exposed to strong ground shaking caused by earthquakes compared to other countries around the world. Considering the earthquakes that have caused significant damage in Japan over the last 200 years, on average, subduction-zone earthquakes have occurred approximately once every 20 years, and shallow crustal earthquakes have occurred approximately once every 10 years. Even if there have been no recent earthquakes in your region, it does not necessarily mean that your region is safe. Even in areas where the probability of ground shaking is relatively low, we must prepare ourselves for earthquakes. Large earthquakes, such as the 1983 Japan Sea Earthquake (M7.7), the 2005 Offshore West of Fukuoka Prefecture Earthquake (M7.0), and the 2007 Noto Peninsula Earthquake (M6.9) caused severe damage due to strong shaking in such low-probability areas. It can be said that the 1995 Hyogoken Nanbu Earthquake (M7.3) and the 2016 Kumamoto Earthquake (M7.3) caused extremely strong shaking in areas with a relatively high probability. Nevertheless, these earthquakes occurred in places where large earthquakes had not been documented recently.

● Seismic Hazard Maps contain uncertainties

Seismic hazard maps are created based on data from the latest findings; however, the available information is limited. Therefore, the results involve uncertainties. For example, seismographs have only been installed for just over 100 years since the Meiji era (1868-1912); thus, modern observations cover a very short period in the long history of earthquakes. In addition, there are areas in Japan where investigations of active faults are still insufficient. For these reasons, seismic hazard maps contain uncertainties and even if the probability is low at present, future investigations may reveal the existence of previously unknown past large earthquakes or active faults, which may increase the probabilities of earthquake occurrences.