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JMA's mascot is named Harerun (from hare - the Japanese word for “fine weather”), and incorporates elements of sun, cloud and rainfall. Harerun holds a green baton representing hopes for a peaceful and disaster-free world. The mascot helps to raise public awareness of meteorological services as well as natural disasters and global environmental issues at various events.
Japan has four clearly defined seasons and is blessed with a beautiful natural environment. However, nature sometimes strikes mercilessly with torrential rains and big earthquakes. Global warming caused by greenhouse gases emitted from human activities has also led to increasingly pressing concerns in recent years.

The Japan Meteorological Agency (JMA) has provided services to protect people and their property from disasters by monitoring and predicting natural events for over a century since it was inaugurated as the Tokyo Meteorological Observatory in June 1875.

Today, its 5,300 employees nationwide constantly monitor heavy rain, typhoons, earthquakes, volcanoes, climate change and other variables.

This pamphlet highlights the services of JMA.
Emergency Warning System
A New Service to Protect Life

Massive damage is caused by natural phenomena of extraordinary magnitude in Japan, as exemplified by the major tsunami caused by the 2011 Great East Japan Earthquake and heavy rain caused by Typhoon Talas in the same year. In response to these natural hazards, JMA issued warnings and various other messages. However, in some cases there was no effective means of informing municipalities and residents of a significant risk of imminent fatal disaster in association with natural phenomena on a scale far exceeding the regular warning criteria, and existing warnings and other information did not prompt residents to evacuate urgently. Based on these experiences, JMA introduced a system of Emergency Warnings on 30 August 2013, to highlight such hazards.

For Severe Weather
Emergency Warnings are issued if heavy rain or other phenomena on a scale observed only once every few decades is predicted.

Criteria for Emergency Warnings

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy rain</td>
<td>*Heavy rainfall with a level of intensity observed only once every few decades is predicted in association with a typhoon or similar. In case of a heavy rainfall with a level of intensity observed only once every few decades, a coastal area is selected as a target area for warning issuance.</td>
</tr>
<tr>
<td>Storm</td>
<td>A storm is predicted in association with a typhoon expected to have a level of intensity observed only once every few decades or an extratropical cyclone with comparable intensity.</td>
</tr>
<tr>
<td>Storm surge</td>
<td>A storm surge is predicted in association with a typhoon expected to have a level of intensity observed only once every few decades or an extratropical cyclone with comparable intensity.</td>
</tr>
<tr>
<td>High waves</td>
<td>High waves are predicted</td>
</tr>
<tr>
<td>Snowstorm</td>
<td>A snowstorm is predicted in association with an extratropical cyclone expected to have a level of intensity observed only once every few decades.</td>
</tr>
<tr>
<td>Heavy snow</td>
<td>Heavy snowfall with a level of intensity observed only once every few decades is predicted.</td>
</tr>
</tbody>
</table>

JMA’s website provides objective criteria for variables such as rainfall amounts used for the definition of a level of intensity observed only once every few decades.

If an Emergency Warning is issued:
• An extraordinary phenomenon of a magnitude never experienced by local residents is likely to occur.
• The possibility of a catastrophe is significant.
• Immediate action should be taken to protect life.

Routine preparedness and early action for natural hazards saves lives:
• Remember that catastrophes may occur even if no Emergency Warning is in effect.
• Take early action with reference to Warnings, Advisories and relevant bulletins.
• Check evacuation routes and centers constantly.

Pay attention to the latest bulletins and follow municipal evacuation advisories and orders in order to protect your life

Emergency Warnings are disseminated through administrative organs and wide variety of media. Residents should look out for relevant messages.

For Earthquakes, Tsunamis and Volcanic eruptions
Major Tsunami Warnings and certain other warnings are issued in the classification of Emergency Warnings.

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>Seismic intensity of 6.0 or more is expected. (Earthquake Early Warnings incorporating prediction of tremors measuring 6.0 or more on JMA’s seismic intensity scale are issued in the classification of Emergency Warnings.)</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Tsunami height is expected to be greater than 3 meters. (Major Tsunami Warnings are issued in the classification of Emergency Warnings.)</td>
</tr>
<tr>
<td>Volcanic eruptions</td>
<td>Eruption or possibility of eruption that may cause serious damage in residential areas and non-residential areas near the crater (Volcanic Warning (Level 4 and 5) and Volcanic Warning (residential areas)* are issued in the classification of Emergency Warnings.)</td>
</tr>
</tbody>
</table>

* When residential areas are not defined, residential areas are replaced with foot-of-mountain areas.
Observation Networks

For Better Monitoring of Atmospheric Phenomena

JMA operates an array of networks involving surface-based observation and the use of meteorological satellites to monitor the atmosphere around the clock. After a process of stringent quality control, the results are made available to the public and related users. The data produced are essential in clarifying atmospheric conditions, and are used for daily weather forecasts, severe weather monitoring, typhoon analysis and climate change monitoring.

**Satellite Observation**

Satellite observation is indispensable for obtaining a clear picture of typhoons over ocean areas and other global atmospheric conditions. The Eastern Asia, Western Pacific and Oceania regions are covered by JMA's Himawari geostationary meteorological satellites (himawari is the Japanese word for sunflower), whose half-hourly observations from 35,800 km above the equator produce data on the distributions of clouds, moisture and volcanic ash, upper-air winds and sea surface temperatures. JMA and a variety of National Meteorological and Hydrological Services (NMHS) make extensive use of Himawari data in daily operations.

**Radar Observation**

Twenty Doppler weather radars are used to observe rainfall/snowfall intensity rationally, and also provide information on the movement of thunderclouds that may bring hazardous rain/snowy conditions. The radars also observe upper-air wind fields, and enable the detection of potentially tornado-generating meso-cyclones.

**Upper-air Observation**

To clarify meteorological conditions and three-dimensional atmospheric activity, upper-air monitoring is performed via radiosonde and wind profiler observation networks.

**Surface Weather Observation**

A total of 160 JMA weather stations, including Local Meteorological Offices, across the country routinely collect data on variables such as surface pressure, temperature, humidity, wind, precipitation, sunshine duration, snow depth, visibility and current weather conditions. As many as 1,300 AMeDAS (Automated Meteorological Data Acquisition System) stations automatically observe precipitation, temperature, wind and sunshine duration. Around 300 of these also observe snow depth.

**Radarsonde**

Radiosondes measure pressure, temperature, humidity and wind in the atmosphere at altitudes of up to 30 km from the surface twice daily.

**Upper-Air Observation Network**

- Radiosonde stations (16)
- Wind profiler stations (25)
Weather Analysis and Prediction
For Appropriate Forecasts and Warnings

Numerical Weather Prediction
Future weather is predicted by calculating differences from current conditions using a numerical weather prediction (NWP) model on a supercomputer.

Weather Maps
Weather maps showing isobars, center positions/intensities of highs and lows and locations of fronts are made using a variety of weather observation data. Forecasters use various weather maps to determine future weather conditions.

Weather Forecasting
Weather forecasts, Emergency Warnings, Warnings and Advisories are issued mainly for natural disaster preparedness and mitigation based on observation data from around the world and NWP products. The service’s accuracy, reliability and level of detail have been improved over the years based on forecaster expertise and the progress of NWP.

Monitoring
Forecasters monitor changes in weather conditions such as torrential rain, tornadoes and thunderstorms to enable the issuance of appropriate weather information that will help mitigate the effects of natural disasters.

Utilization of Data from Other Organizations
JMA also collects data gathered by other national and local organizations in Japan as well as National Meteorological and Hydrological Services (NMHS) and relevant organizations around the world.

For Weather Disaster Preparedness and Mitigation
Local Meteorological Offices (LMOs) issue a variety of bulletins such as Emergency Warnings, Warnings and Advisories (see page 18) so rivers and information on debris flow, slope failure and other hazards (see page 18) in collaboration with national and prefectural governments.

LMOs issue Emergency Warnings, Warnings and Advisories for individual municipalities and their residents.

Example of a Warning/Advisory

Typhoon forecast briefing (at Tokyo Metropolitan Gov Office)

Telephone briefing on weather conditions for a local government

LMOs also hold briefing sessions on typhoon forecasting for prefectural disaster management agencies and the media, and also caution municipalities on adverse weather conditions.

If a catastrophe is expected to result from an extraordinary natural phenomenon such as a typhoon, LMOs inform national and local government staff of forecast peak times and durations of severe weather conditions such as heavy rain and gales at disaster mitigation meetings. LMO staff also provide governments with advice on weather condition by telephone and other means.
Monitoring of the Global Environment
For a Better Understanding of Our Earth

JMA carries out observation and monitoring related to environmental issues such as global warming and ozone layer depletion as well as prediction of global warming, and makes the results public. The Agency also provides information on oceanic phenomena such as El Niño, which significantly affects extreme climate events around the world.

Observation

- Weather conditions/phenomena
- Greenhouse gases
- Ozone layer and ultraviolet radiation
- Oceanographic conditions/phenomena

Analysis and Prediction

- Global warming projection
- Extreme climate events
- Ozone layer and ultraviolet radiation
- Marine Diagnosis Reports

Monitorin of Phenomena

Global warming
Ozone layer and ultraviolet radiation
Greenhouse gases
Volcanic dust
Aeolian dust

El Niño
La Niña

Sea ice
Sea temperature and current

Monitoring of the Climate

JMA monitors extreme climate events around the world and related phenomena such as El Niño and La Niña. The Agency also runs and develops a global general circulation model to calculate variables such as wind and sea currents for seasonal climate outlooks and future climate projection (see pages 21 and 22).

Assessment of recent extreme climate events
Sea surface temperature anomaly during an El Niño event (Nov. 1997)

Monitoring of the Atmospheric Environment

JMA observes elements of the atmospheric environment such as greenhouse gases at several stations. Its Minamitorishima location is one of the most important monitoring spots in the world because it is located more than 2,100 km from the continent and is therefore relatively unaffected by local anthropogenic emissions.

Overview of Minamitorishima
Greenhouse gas observation at Minamitorishima

Monitoring of Oceans

JMA conducts oceanographic observation (water temperature, salinity, carbon dioxide, etc.) using two research vessels and operates profiling floats to monitor the long-term variability of the marine environment and global warming.

JMA’s two research vessels are named the Ryofu Maru (1,880 tons) and the Kefu Maru.
Oceanographic observation
Seawater collection and carbon dioxide analysis
On-board analysis

Observation Network for the Global Environment

JMA monitors greenhouse gases, ozone, solar radiation and other atmospheric components at several ground observation stations. The Agency also observes greenhouse gases in seawater using research vessels and carries out greenhouse gas observation in the upper air using aircraft in collaboration with Japan’s Ministry of Defense.

- Global environment observation station
- Research vessel observation route
- Aircraft observation route

Global environment observation network
Monitoring of Earthquakes, Tsunamis and Volcanic Activity
For the Provision of Timely Information

**Monitoring of Earthquakes**
JMA collects real-time data from around 1,500 seismometers and around 4,300 seismic intensity meters deployed throughout Japan to support the monitoring of earthquakes around the clock.

**Tsunami Database**
To enable immediate issuance, JMA has conducted computer simulation of tsunamis with earthquake scenarios involving various locations and magnitudes. The results detailing tsunami arrival times/heights and other outcomes are stored in a database.

**Earthquakes Analysis, Tsunami Forecasting and Monitoring**
When an earthquake occurs, JMA promptly estimates its location, magnitude and related tsunami risk. Seismic intensities observed throughout Japan are promptly announced in Seismic Intensity Information bulletins, which are used to support the implementation of disaster mitigation measures by related management authorities.

**Monitoring for Tokai Earthquake Prediction**
Earthquake prediction largely remains in the research stage except in relation to the Tokai Earthquake. To support the prediction of this expected tremor, JMA has developed a seismic and crustal deformation observation network covering the region in conjunction with related organizations, and observes relevant data around the clock. The Agency is responsible for convening the Earthquake Assessment Committee for Areas under Intensified Measures against Earthquake Disaster in the event of anomalous phenomena to determine whether such abnormalities are precursors to the Tokai Earthquake.

**Monitoring of Volcanic Activity and Issuance of Volcanic Warnings**
Among Japan’s 110 active volcanoes, 47 selected by the Coordinating Committee for Prediction of Volcanic Eruptions are continuously monitored using seismometers, tiltmeters, GPS and other tools. When unusual phenomena are observed, JMA reinforces its monitoring efforts and implements mobile observation if necessary. The Agency also issues Volcanic Warnings (see page 20) specifying target areas for caution based on the results of observation, monitoring and evaluation.

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Japan is one of the world’s most earthquake- and volcano-prone countries, and has suffered repeated damage from such disasters as well as tsunamis.

To reduce damage caused by earthquakes, tsunamis and volcanic eruptions and to protect life and property, JMA monitors real-time data from seismometers, tsunami observation facilities and instruments installed near active volcanoes around the clock and issues a range of disaster mitigation information.
International Cooperation

Forecasting

Tsukasa FUJITA
Head, Tokyo Typhoon Center

The Asia-Pacific region is highly prone to natural disasters, most of which are caused by tropical cyclones (TCs). The Tokyo Typhoon Center (TTC) is in charge of monitoring, analyzing and forecasting elements of TC behavior in the western North Pacific, including movement, changes in intensity and associated severe weather phenomena. In addition to these national services, TTC is responsible for issuing TC warnings/advisories to the international community in its role as a Regional Specialized Meteorological Centre as designated by the World Meteorological Organization (WMO).

The Center also helps to improve the TC forecasting capacity of developing countries in the Asia-Pacific region through training courses and expert missions in cooperation with relevant partners, such as WMO and the Japan International Cooperation Agency. In November 2013, TC Haiyan (known as Yolanda in the Philippines) claimed more than 6,000 victims in the Philippines with storm winds and surges. The disaster highlighted the need for more effective regional cooperation to mitigate the effects of TC disasters in the region. TTC is committed to further enhancing its provision of TC-related products for disaster mitigation activities and its other services in support of its continued leading role in TC disaster mitigation for the region.

International Communication

Kenji TSUNODA
Senior Scientific Officer, Information and Communications Technology Division

The communication environment surrounding WMO has advanced significantly with the rapid development of Internet technology. This has made it possible to meet potential demand for the efficient transmission of huge amounts of information (such as satellite data and numerical weather prediction (NWP) products) in recent years.

Against such a background, data management and utilization (i.e., how target data can be extracted from huge bodies of information and used effectively) will be important future considerations in addition to the principal information delivery role of meteorological communication work.

I intend to work towards the ever-growing requirements of the field with focus on improving service levels and convenience based on new technology, and to maintain favorable relations with users.

Jitsuko HASEGAWA
Scientific Officer, Information and Communications Technology Division

Earth science provides the perfect environment for international work because weather, the climate and the water cycle know no borders. Having studied geophysical fluid dynamics and information management, I have worked for nearly 10 years in the field of data representation and cataloging for international exchange of observation data and simulation model products. These efforts have mainly been within the framework of international programs led by the World Meteorological Organization. The most exciting part of international cooperation in the field is being involved in the processes of building a consensus on technical solutions and implementing them, which requires a good balance of new ideas and consideration for meeting the needs at hand. Through various activities at international, regional and national levels, my career has shown me new ways of looking at world and getting things done, and most importantly, has introduced me to people full of passion and enthusiasm. In addition to the technological outcomes we have achieved, the cooperative relationships and friendships we have built with numerous national meteorological services - especially those in Southeast Asia - represent lasting achievements for the Agency and for me personally. I remain as enthusiastic as ever about new encounters with people and opportunities to make a difference.

Global Environment

Hiroshi KOIDE
Senior Coordinator for Global Atmosphere Watch

The World Data Centre for Greenhouse Gases (WDCGG) is one of six WDCs under the WMO Global Atmosphere Watch (GAW) Programme. It gathers, archives and provides data on greenhouse gases (GHGs: CO₂, CH₄, N₂O, N₂O, surface ozone and others) and reactive gases (RGS: CO, NOₓ, SOₓ, VOCs and others) in the atmosphere and ocean as observed under the GAW program.

On behalf of the WDCGG, I would like to express my sincere gratitude to data contributors from all over the world for their quiet dedication and perseverance, and among others, particularly to those at background stations located at high mountains, isolated islands, and in pristine tropical forests or frozen zones, where living itself poses sometimes many difficulties (CAS-16/Doc. 6.2/para. 6.2.1.3). I work as a liaison officer between JMA and WMO GAW and as a member of related Science Advisory Groups and the Expert Team on WDCs under GAW. I feel proud that JMA serves relevant science communities by operating the WDCGG and contributing via the provision of WMO Greenhouse Gas Bulletins, which are among WMO’s most successful publications.

In 2012, the WDCGG started a five-year process of fundamental reform for its services to better cater to the needs of data contributors and users. This work is registered as a ministerial-level initiative in JMA, and I lead the reform supported by my colleagues in consultation with the science community and the WMO Secretariat.

Ryuji YAMADA
Senior Scientific Officer, Tokyo Climate Center

The Tokyo Climate Center (TCC) assists operational climate services provided by National Meteorological and Hydrological Services (NMHS) in the Asia and Pacific region. Its main activities involve the provision of climate data and products to NMHS through its website and assistance with capacity development at NMHSs in the region.

As part of its capacity-development activity role, TCC organizes annual training seminars on the application of its climate monitoring and prediction products for officials invited from NMHSs in the region. The seminars focus on practical exercises. The Center also arranges visits by its experts to and hosts visitors from NMHSs.

TCC hosts a WMO Regional Climate Center in Asia (RCC Tokyo (Regional Association (RA) II)) and a Global Producing Center for Long-range Forecasts (GFC Tokyo), and remains committed to enhancing its assistance activities to meet the needs of NMHSs.

As the atmosphere has no national borders, international cooperation and coordination are essential for the development of worldwide activity in the field of meteorology. JMA devotes considerable resources to a number of WMO regional and global centers in a variety of fields, including weather forecasting, international communications and the global environment.
International Cooperation

Observation

Yoshiro TANAKA
International Strategy Officer for Meteorological Observation

Observation efforts are the very foundation of every meteorological service. Official meteorological observation was begun in Tokyo in 1875 with the help of British engineer H. B. Joyner, which was probably the first instance of international cooperation on meteorological services in Japan. Embracing the spirit of Joyner’s efforts in the 19th century, I feel greatly honored to have the opportunity of helping to bridge the observational gap that still exists here in the 21st century between countries with different backgrounds. One of my duties is to develop strategy for pragmatic approaches based on international cooperation with national meteorological services around the world. I believe there is still plenty of room for enhancements to meteorological services worldwide, including improvements to the quality and availability of data produced by activities ranging from traditional in-situ observation to cutting-edge remote sensing.

Toshiyuki KURINO
Director, Data Processing Department, Meteorological Satellite Center (MSC)

JMA has provided essential satellite imagery for modern meteorological services since its first satellite was launched in 1977, and is now preparing for the operation of its next-generation Himawari-8/9 geostationary meteorological satellites (to be launched in 2014 and 2016, respectively). With significantly enhanced imagers on board, the new satellites will in particular improve observation of rapidly changing meso-scale phenomena and the derivation of quantitative products.

Oceans and Tsunamis

Nadao KOHNO
Group Leader of Marine Modeling Unit, Office of Marine Prediction

I am responsible for developing and improving JMA’s numerical models related to marine phenomena, such as ocean waves and storm surges. Although the models are intended for use in JMA’s operational work, to support the issuance of marine meteorological information, forecasts from JMA’s Global Wave Model and Asian Region Storm Surge Model are widely used by National Meteorological and Hydrological Services (NMHSs) for issuance of their own information. A number of NMHSs have recently expressed a keen interest in operating their own numerical models for waves and storm surges. JMA has a high level of expertise in this field, and is often asked by NMHSs to give support in the form of training courses on wave/storm surge forecasts or the provision of numerical models. My work has taken me to numerous Asian and African countries, including Malaysia, Thailand, Bangladesh and Kenya, as a lecturer at workshops organized by WMO and other organizations. NMHS staff occasionally visit JMA to undergo training, and I keep in touch with attendees to provide follow-up support and help them to install and run models for operational use. I take great pleasure in the fact that the models we have developed are used for operational forecasts in a number of other countries rather than only by JMA. To further develop the Agency’s models, it is crucial to incorporate the latest scientific and technological knowledge. I am committed to refining these models in order to make them as accurate and reliable as possible.

Kouichi NAKASHIMA
Scientific Officer, Meteorological Instrument Center

I am in charge of practical operations at the WMO Regional Instrument Centre (RIC) Tsukuba. Globally uniform high-quality meteorological data are needed for accurate weather forecasting and appropriate monitoring of climate change. Regular calibration and maintenance of meteorological instruments are very important for accurate observation of atmospheric conditions, and calibration must be traceable to international standards. The main functions of RICs involve assisting Region Members to calibrate their national meteorological standards and responding to their enquiries on instrument performance, maintenance, the availability of relevant guidance materials and other matters. I hope these RIC activities will help Members to improve their meteorological observation data. The RIC Tsukuba website provides information on standard instruments, RIC Tsukuba calibration equipment and useful materials for instrument calibration and maintenance (http://www.jma.go.jp/jma/jma-eng/jma-center/ric/ric_hp.html).

Takeshi KOIZUMI
Senior Coordinator for International Earthquake and Tsunami Information

Tsunamis move across oceans without regard to national borders, often causing serious damage over extensive coastal areas. JMA works with UNESCO/IOC* and contributes to tsunami disaster mitigation all over the world. In particular, the Agency makes a major contribution to the Pacific intergovernmental cooperation framework known as ICG/PIWST through 1) the leading role I have played as Vice-Chair since May 2011, and 2) the operation of the Northwest Pacific Tsunami Advisory Center, which provides information on tsunami forecasting in the western North Pacific and, on an interim basis, the South China Sea. JMA also helps with the development of the CTBT* verification regime by providing seismic waveform data from its stations.

I very much enjoy working with my colleagues around the world to coordinate such joint efforts among international organizations and to collaborate with a variety of organizations in the field of earthquakes and tsunamis.

*1 Intergovernmental Oceanographic Commission
*2 Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
*3 Comprehensive nuclear test Ban Treaty

I promote Himawari-8/9 data utilization in East Asia and the Western Pacific within the framework of the Coordination Group for Meteorological Satellites (CGMS), whose members are WMO and other meteorological satellite operators (China, Europe, India, Korea, Russia and the US). JMA engages in particular collaboration with the US NOAA/NESSDS and Europe’s EUMETSAT through the mutual sharing of information on related scientific progress. A future challenge for me lies in realizing joint international development toward the creation of common scientific software for seamless determination of weather parameters by all meteorological satellite operators.

Photo at the French Tsunami Warning Center
Meteorological Information for Aviation and Maritime Safety

For Aviation Safety

Aircraft are continuously affected by weather conditions from take-off to landing. To support safe, efficient aircraft operation, JMA provides air traffic service units of the Japan Civil Aviation Bureau (JCAB) and airlines with meteorological information collected/produced both for aerodromes and airspace in compliance with the standards of the International Civil Aviation Organization (ICAO) and the World Meteorological Organization (WMO).

- Monitoring at Aerodromes
  - Issuance of forecasts and warnings
  - Observation by human observers
  - Observation using instruments (wind direction/speed, etc.)

JMA provides timely meteorological reports to air traffic controllers and pilots based on minute-to-minute monitoring of constantly changing weather conditions.

- Monitoring of Airspace
  - Monitoring and forecasting of weather in airspace
  - Monitoring and forecasting of volcanic ash clouds

For Maritime Safety

To support safe, cost-effective maritime navigation in bad weather, JMA issues various kinds of information such as data on marine weather, ocean winds, wave heights, sea surface temperatures and ocean currents for ships in the western North Pacific and coastal areas around Japan. The Agency is responsible for creating and issuing warnings and weather/marine information through the International SafetyNET system under the framework of the Global Maritime Distress and Safety System (GMDSS) for high seas in the western North Pacific and elsewhere.

- Issuance of Marine Warnings and Wave Forecast Charts

Support for Private-sector Services

JMA provides a variety of meteorological data and products to private operators in the weather service sector to aid their commercial services. Real-time and archived data are provided online and via electronic media, respectively, through the Japan Meteorological Business Support Center (JMBSC, a general incorporated foundation designated by the Director-General of JMA).

- Provision to JCAB and Airlines
  - Pilots and operators
  - Aircraft operations affected by adverse weather

JMA’s Air Traffic Meteorology Center (ATMec) staff work in the same operation room as JCAB’s Air Traffic Management Center (ATMC) staff in Fukuoka to ensure smooth and flexible operation of aircraft on route.

- Data Products Delivery Services
  - For the safety of people engaging in outdoor activities
  - Purchase and inventory control based on forecasting
  - Automated machine control using the Earthquake Early Warning System

- Customers

Meteorological information is imperative for the safe operation of aircraft and marine vessels. JMA provides aviation stakeholders and maritime operators with specialized information to meet their specific needs.
Information Provided by JMA
For Weather Disaster Mitigation

Provision of Disaster Mitigation Information

Japan Meteorological Agency
- JMA website [http://www.jma.go.jp/]
- Prefectural governments
- National Police Agency
- NTT (Nippon Telegraph and Telephone Corporation)
- Fire and Disaster Management Agency
- Water and Disaster Management Bureau, MLIT*
- Electrical Power Companies
- NHK (Japan Broadcasting Corporation)
- Media Organizations
- Private Weather Services
- Japan Meteorological Business Support Center
- Japan Coast Guard
- Japan Civil Aviation Bureau
- Service Users
- Ministry of Land, Infrastructure, Transport and Tourism

*MLIT: Ministry of Land, Infrastructure, Transport and Tourism

Tropical Cyclone Information

JMA monitors tropical cyclone (TC) activity over the western North Pacific and the South China Sea, and issues TC advisories every three hours to provide relevant information including analysis and forecasts of location, intensity, and movement up to three days ahead. The Agency also issues five-day TC track forecasts every six hours for TCs expected to maintain tropical storm intensity or more severe levels over the next three days.

Three-day Tropical Cyclone Forecast

Five-day Tropical Cyclone Forecast

Information for Severe Weather Preparedness

JMA issues a variety of messages as detailed below in response to current and forecast weather conditions so that appropriate measures can be taken to mitigate possible issues such as damage from storms/flooding and damage brought by such hazards as debris flow and slope failure caused by tropical or extra-tropical cyclones and fronts.

Emergency Warnings/Warnings/Advisories

Emergency Warnings are issued if there is significant likelihood that a catastrophe will be caused by a natural phenomenon of a scale expected to exceed the warning criteria. Warnings are issued if there is a chance of catastrophe caused by weather phenomena that meet the relevant warning criteria. Advisories are issued if there is potential for the development of serious adverse conditions that meet advisory criteria but remain below the warning criteria.

- **Emergency Warnings:**
  - Storm-Snowstorm, Heavy Rain, Heavy Snow
  - Storm-Surge and High Waves
- **Warnings:**
  - Storm-Snowstorm, Heavy Rain, Heavy Snow, Storm surge, High waves and Flood
  - Gale and Snow, Gale, Heavy rain, Heavy Snow, Dense Fog, Thunderstorm, Dry air, Avalanche, Ice/Snow accretion, Frost, Low temperature, Snow-melting, Storm surge, High waves and Flood
- **Advisories:**

Bulletins

Bulletins are issued to alert the public to weather conditions before Warning/Advisories are issued and to supplement Warnings.

Bulletins on Exceptionally Heavy Downpours

Bulletins on Exceptionally Heavy Downpours are issued when a downpour with a scale seen only once every few years has been observed or analyzed in the last hour.

Information on debris flow, slope failure and other hazards

In association with the issuance of Heavy Rain Warnings, information on debris flow, slope failure and other hazards is issued jointly by MLITs and civil engineering bureaus of prefectural governments when damage from such hazards caused by heavy rain is considered likely within the next few hours.

Flood Warnings and Advisories for designated rivers

JMA issues Flood Warnings and Advisories for designated rivers with information on water levels or flow rates in collaboration with national and prefectural river authorities for rivers deemed prone to flood disasters by these organizations.

Hazardous Wind Watch

Hazardous Wind Watch alerts supplement Thunderstorm Advisories to warn of a high probability of hazardous winds such as tornadoes and downbursts.

Radar/Rain gauge Analyzed Precipitation and Very-Short-Range Forecasts of Precipitation

Radar/Rain gauge Analyzed Precipitation data show the distribution of one-hour precipitation. Very Short-Range Forecast of Precipitation reports are issued to provide forecasts of hourly precipitation amounts for the next six hours.

Nowcasts (Precipitation, Thunder and Tornadoes)

Nowcasts provide forecasts of precipitation intensity, thunder activity and the probability of hazardous winds such as tornadoes and downbursts up to an hour ahead.
Information on Earthquakes and Tsunamis

Earthquake Early Warnings
Earthquake Early Warnings (EEWs) provide advance notice of estimated seismic intensities and expected arrival times of principal motion just after an earthquake occurs. If the estimated maximum seismic intensity is 5 or lower, EEWs (warnings) are issued for regions with estimated seismic intensities of 4 or more.

Seismic Intensity Information
This information specifies the time of earthquake occurrence and identifies regions where seismic intensity levels of 3 or greater have been observed (issued within 90 seconds of the earthquake).

Tsunami Warning/Advisory
When an earthquake occurs, JMA estimates whether a tsunami has been generated. If disastrous waves are expected in coastal regions, a Tsunami Warning/Advisory is issued.

<table>
<thead>
<tr>
<th>Category</th>
<th>Indication</th>
<th>Actions to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Tsunami Warning*</td>
<td>Tsunami height is estimated to exceed 3 meters.</td>
<td>Evacuate from coastal or river areas immediately to safer places such as high ground or a tsunami evacuation building.</td>
</tr>
<tr>
<td>Minor Warning</td>
<td>Tsunami height is estimated to be 1 - 3 meters.</td>
<td>Get out of the water and leave coastal areas immediately.</td>
</tr>
<tr>
<td>Tsunami Advisory</td>
<td>Tsunami height is estimated to be 0.2 - 1 meter.</td>
<td>Stay calm and keep safe.</td>
</tr>
</tbody>
</table>

*Tsunami Warnings are issued in the classification of Emergency Warnings. → p. 1, 2

Earthquake and Seismic Intensity Information
This information specifies the tremor’s hypocenter and magnitude. It also identifies cities/towns/villages where seismic intensity levels of 3 or greater have been observed and those where the estimated seismic intensity is 5 or lower but related observation data are incomplete.

Information on Seismic intensity for individual locations
This information specifies the tremor’s hypocenter and magnitude. It also identifies individual locations where seismic intensity levels of 1 or greater have been observed and those where the estimated seismic intensity is 5 or lower but related observation data are incomplete.

Other Information
JMA also issues other reports such as information on Seismic Activity later.

Information on the Tokai Earthquake
JMA issues Tokai Earthquake Assessment Reports (Regular) after monthly assessment of data collected in the Tokai region. If anomalies are detected, JMA issues other information on the Tokai Earthquake to allow preparatory action and emergency measures for earthquake disaster mitigation.

<table>
<thead>
<tr>
<th>Information issued by JMA</th>
<th>Action to be taken by public organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokai Earthquake Precution Information</td>
<td>Establishment of Headquarters for Earthquake Disaster Prevention</td>
</tr>
<tr>
<td>Tokai Earthquake Cautionary Information</td>
<td>Preparatory action based on prevention plans</td>
</tr>
<tr>
<td>Tokai Earthquake Assessment Report (Extra)</td>
<td>Collection of information</td>
</tr>
<tr>
<td>Tokai Earthquake Assessment Report (Regular)</td>
<td>None</td>
</tr>
</tbody>
</table>

Volcanic Warnings and Alert Levels
JMA issues Volcanic Warnings for 110 active volcanoes in Japan when unusual phenomena are observed. It also sets Volcanic Alert Levels for 30 active volcanoes (as of March 2014) specifying target areas and action to be taken based on local evacuation planning coordinated by regional volcanic disaster management councils.

Focus: Collaborative Activities for Disaster Mitigation in Communities

What should you do if dark clouds approach and it suddenly gets dark?
What should you do if you feel the ground shaking hard in a coastal area?
Local Meteorological Offices (LMOs) work on the implementation of various measures in collaboration with disaster management organizations, educational institutions and the media to help people learn how to respond independently to signs of disaster and to raise awareness of information issued by JMA.

A lesson with teaching materials created jointly by LMO staff and teachers
An LMO staff member on a radio show
Information Provided by JMA
For the Safety and Future of Mankind

Information for Life and Industry

Daily Forecasts
Daily forecasts provide information on weather, winds, coastal ocean waves, maximum/minimum temperatures and probabilities of precipitation covering periods up to two days ahead. They include Distribution Forecasts and Three-hourly Forecasts.

One-week Forecasts
One-week Forecasts provide information on weather, precipitation probability, maximum/minimum temperatures and reliability, and cover the period up to seven days ahead.

Early Warning Information on Extreme Weather
JMA issues such information every Monday and Thursday when a high probability (30% or more) of very high/low seven-day average temperatures or very heavy snowfall is predicted in the week starting five to eight days ahead of the date of announcement.

Seasonal Forecasts
Climate outlook data on variables such as average temperature, precipitation amounts, sunshine durations and snowfall totals for the next one to several months are provided in the form of probability forecasts with three categories of above normal, near normal and below normal.

Information on the Global Environment

Global Warming
JMA provides global maps of carbon dioxide concentrations based on data from around the world. To contribute to the formulation and implementation of climate change mitigation/adaptation measures, the Agency provides numerical climate projections based on results obtained from a high-resolution general circulation model and a convection-permitting regional climate model.

Extreme Climate Events
JMA issues information on extreme climate events around the world.

Research Detailed Global Warming Prediction
How will individual regions of Japan be affected by changes in temperature and precipitation associated with global warming? How should this influence be handled? High-resolution, high-precision climate prediction on a local level is required in order to answer these questions.

Such prediction can be achieved by combining a global change prediction model with a more detailed model for forecasting local changes including the influence of complex geographical features under area limitations.

Distribution of annual average precipitation during the 20 years from the end of the last century as simulated with model downscaling for Japan and its surrounding areas in combination with the global model.

In addition to daily forecasts covering periods up to a week ahead, Early Warning Information on Extreme Weather and climate outlooks with data such as average temperatures and precipitation amounts covering periods up to several months ahead are provided to support agriculture and other industrial operations.
JMA operates the Sapporo, Sendai, Tokyo, Osaka, Fukushima and Okinawa Regional Headquarters to observe and monitor weather and earthquakes and to issue forecasts, warnings and bulletins for these regions. The Regional Headquarters give direction to Local Meteorological Offices for the issuance and provision of information and comments on prefectural and sub-prefectural levels. The Agency operates Aviation Weather Service Centers at major airports to support the safe flow of air traffic.

JMA also operates the Meteorological Research Institute, the Meteorological Satellite Center, the Aerological Observatory, the Magnetic Observatory and the Meteorological College as locations for research and training to support meteorological services.