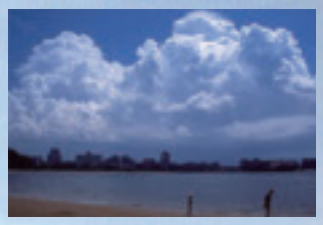
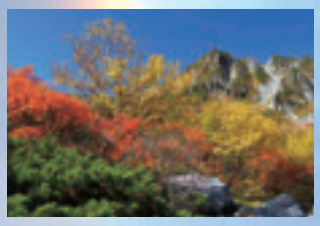
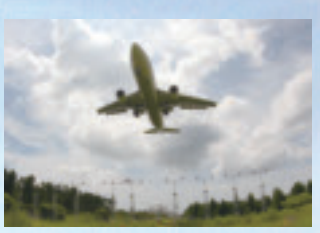
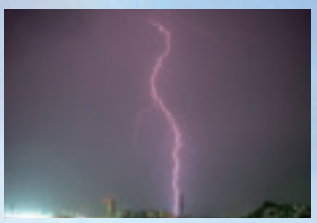







Japan Meteorological Agency

The national meteorological service of Japan

2010

Preface

Because of its geographical and climatological conditions, Japan is subject to frequent natural disasters such as typhoons, torrential rains and heavy snow as well as earthquakes, tsunamis and volcanic eruptions. The Japan Meteorological Agency (JMA) contributes to the safety of people in the country by providing a range of meteorological, oceanographic, seismological and volcanic information.

JMA improves its services by incorporating advanced technologies and checking the management and performance of its operations continuously with the aim of enhancing the effectiveness and efficiency of its activities to cope with new demand. Examples of such improvements include the initiation of five–day forecasts for typhoon tracks as well as Tornado Watch and Earthquake Early Warnings.

In recent years, climate–related matters have become a serious issue worldwide; many nations, including Japan, are concerned with the increased frequency of extreme weather events (such as torrential rains and heatwaves) associated with climate change. National Meteorological Services around the world are required to play an increasingly important role in enhancing disaster prevention and in adaptation to current and future climate conditions. Against this background, JMA constantly strives to improve its services and to promote research on climate change and variability.

As international cooperation is indispensable in implementing meteorological services, JMA regularly contributes to such collaborative projects, particularly in the areas of exchange of data and products, sharing of expertise on meteorology, oceanography, seismology and other related scientific fields, and capacity building for developing countries.

Contents

1 Our Missions

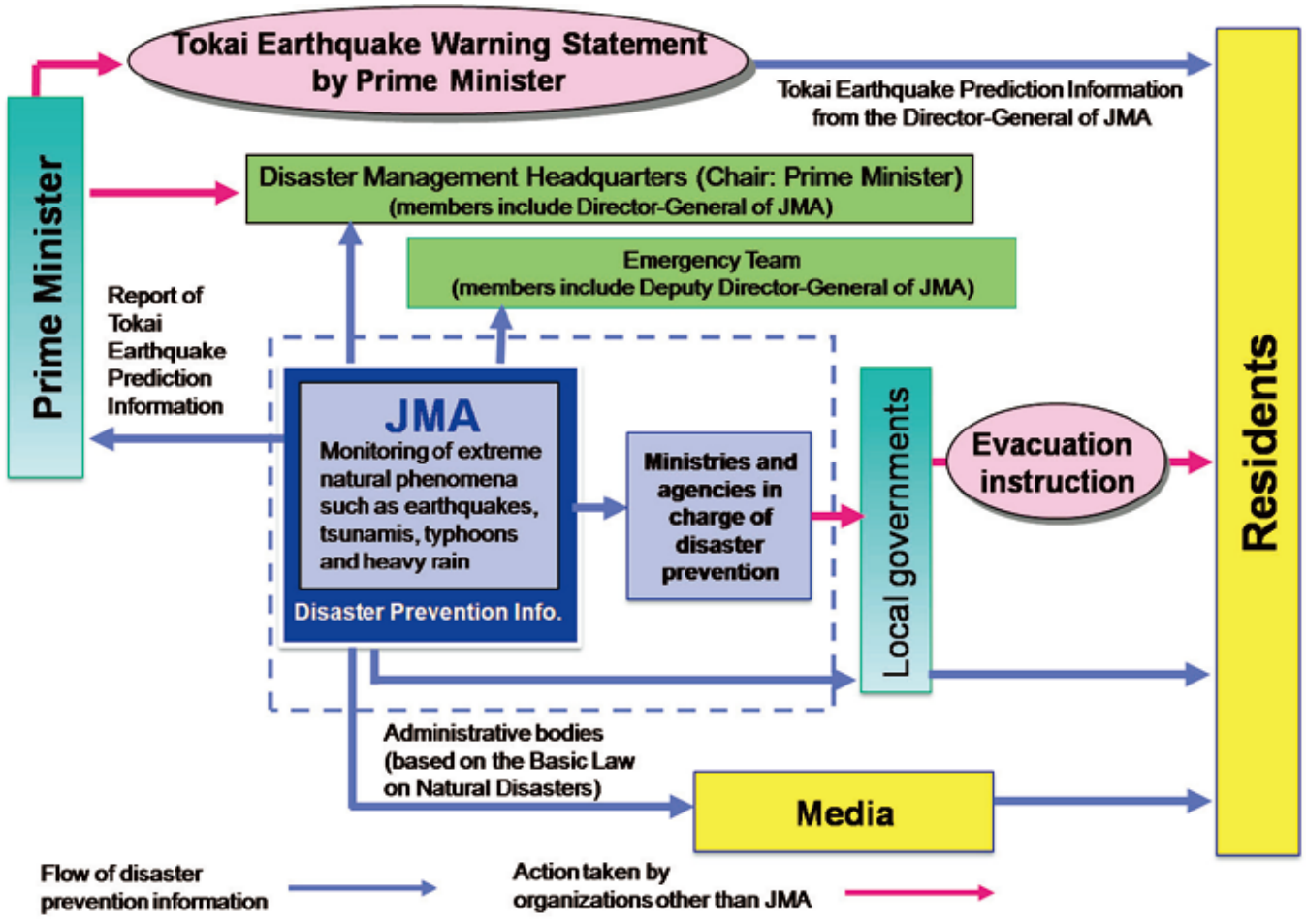
As part of Japan's government, the Japan Meteorological Agency (JMA) implements its services with the following ultimate goals in compliance with the Act for Establishment of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Meteorological Service Act:

- ◇ Prevention and mitigation of natural disasters
- ◇ Safety of transportation
- ◇ Development and prosperity of industry
- ◇ Improvement of public welfare

To meet these goals, JMA focuses its efforts on monitoring the earth's environment and forecasting natural phenomena related to the atmosphere, the oceans and the earth, as well as on conducting research and technical development in related fields. JMA also engages in international cooperation activities regarding both meteorology and seismology to meet Japan's international obligations and to promote partnerships with National Meteorological and Hydrological Services as well as various related international agencies.

Particular emphasis is placed on the prevention and mitigation of natural disasters, as Japan is prone to a variety of natural hazards such as typhoons, heavy rains and earthquakes. JMA, as the sole national authority responsible for issuing weather/tsunami warnings and advisories, is required to provide reliable and timely information to governmental agencies and residents for the purposes of natural disaster prevention and mitigation. In the event of a major earthquake or tsunami, senior government officials from the relevant ministries and agencies are summoned to the Prime Minister's Official Residence to respond to the disaster in an appropriate and coordinated way based on earthquake information and tsunami warnings issued by JMA.

In this way, JMA plays a vital role in natural disaster mitigation and prevention activities in the country through cooperation and coordination with relevant authorities, including the central government and individual local governments.

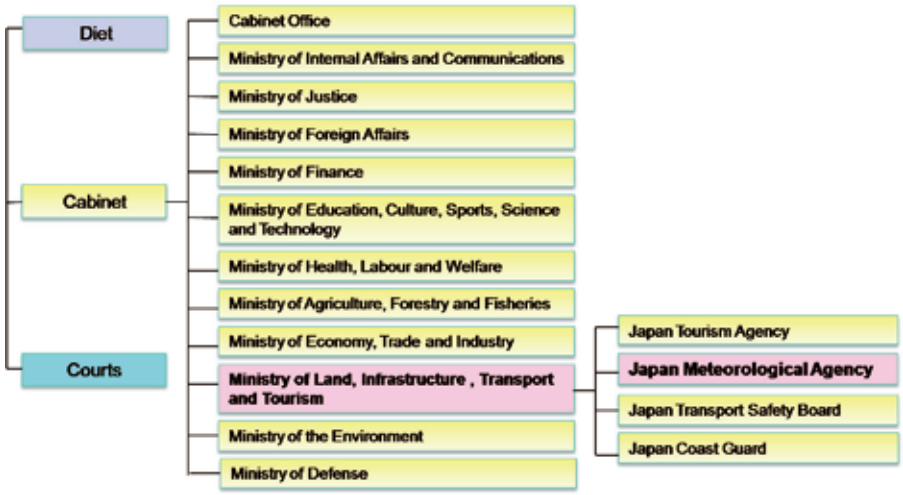


Disaster prevention operation schemes and role of JMA

2 Organizational Structure

Within the structural framework of Japan's central government, the Japan Meteorological Agency (JMA) is placed as an extra-ministerial bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

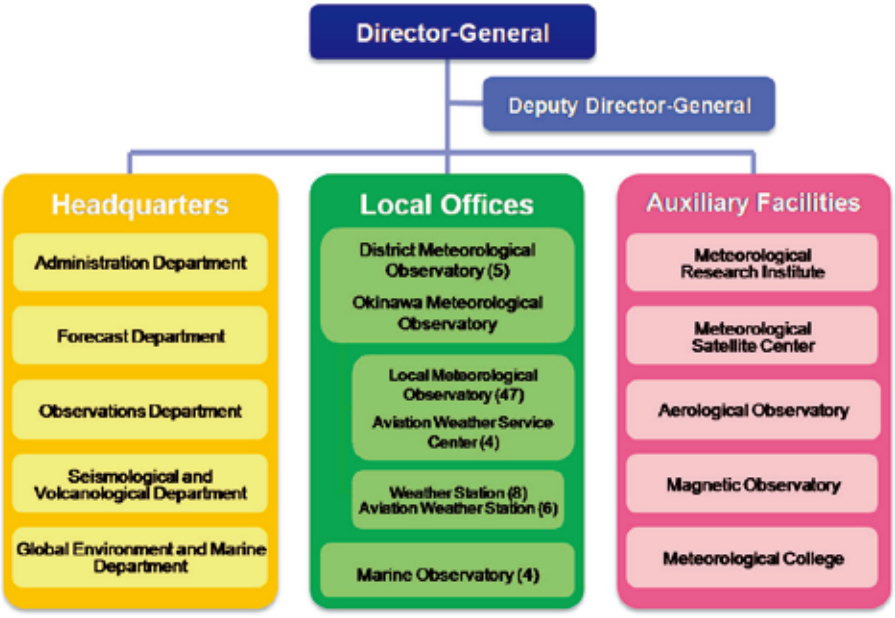
JMA is comprised of Headquarters, District/ Marine/Local Meteorological Observatories and Weather Stations, and Auxiliary Facilities. All JMA services are conducted with a total staff of 5,618 and budgetary resources of 74.9 billion yen (approx. US$800 million) per year as of 2009 FY.



Organizational chart showing the national authorities of Japan

2-1 Headquarters

JMA Headquarters serves as both the administrative and operational center of the Agency. It has a Director-General, a Deputy Director-General and five departments: the Administration Department, the Forecast Department, the Observations Department, the Seismological and Volcanological Department, and the Global Environment and Marine Department.

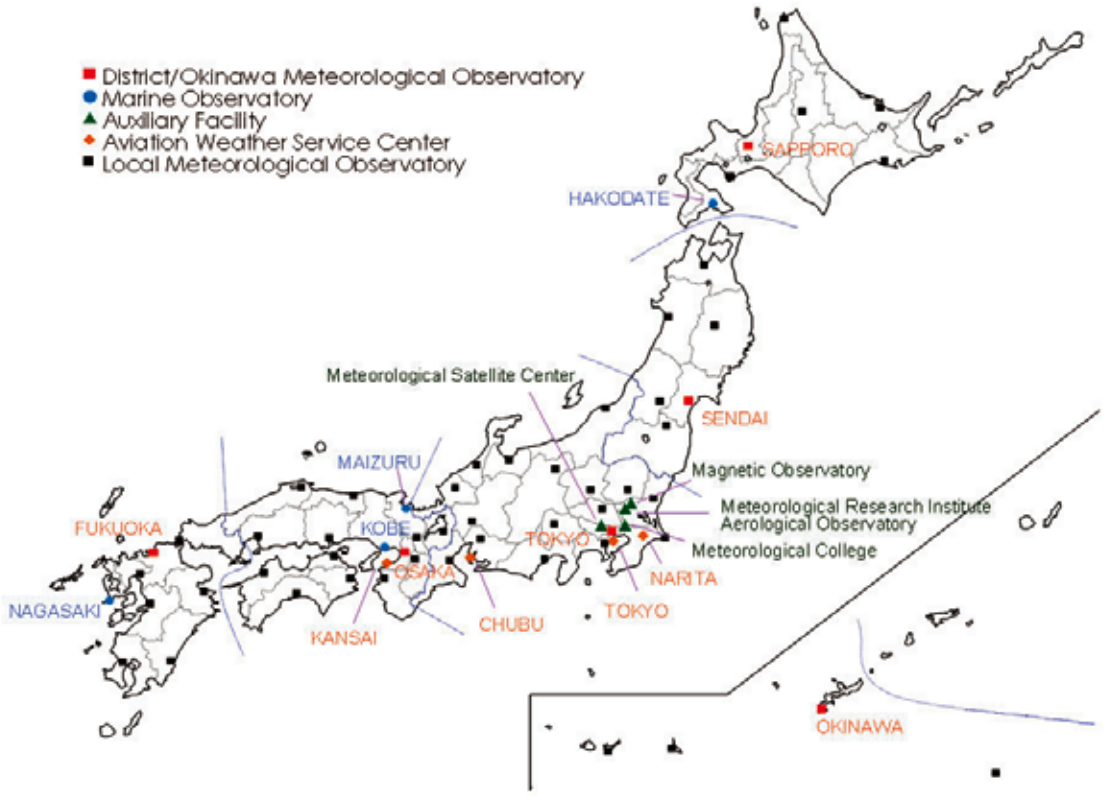


Organizational structure of JMA

2-2 District/Marine/Local Meteorological Observatories and Weather Stations

To provide a wide range of services for local communities, JMA operates a number of observatories and weather stations across the country. Sapporo, Sendai, Tokyo, Osaka, and Fukuoka District Meteorological Observatories (DMOs) and the Okinawa Meteorological Observatory serve as regional central offices directing 47 Local Meteorological Observatories (LMOs), which provide information services at a prefectural and sub-prefectural level, as well as 8 Weather Stations dedicated to observation.

A total of 4 Aviation Weather Service Centers (AWSCs), 6 aviation weather stations and 42 airport branches have been established to support aviation meteorological services. Four Marine Observatories in Hakodate, Kobe, Nagasaki and Maizuru also offer marine meteorological and oceanographic services.



JMA main offices

2-3 Auxiliary Facilities

The JMA auxiliary facilities outlined below are operated to support specialized services such as research, investigation and education/training.

Meteorological Research Institute (in Tsukuba, Ibaraki)

The Meteorological Research Institute (MRI) is a JMA research facility. Its nine research departments cover broad areas of meteorology including weather forecasting, climate, typhoons, physical meteorology and observation systems, as well as other fields related to earth science such as seismology, volcanology, oceanography and geochemistry.

Meteorological Satellite Center (in Kiyose, Tokyo)

The Meteorological Satellite Center (MSC) deals with the meteorological side of the series of Multifunctional Transport Satellites (MTSAT), which carry out earth observation and related telecommunication operations. MSC receives observational data from MTSAT through the Command and Data Acquisition Station (CDAS) located in Hatoyama, Saitama. The Center is also responsible for deriving operational products from MTSAT and other polar-orbiting satellites such as the US NOAA-series of spacecraft.

Aerological Observatory (in Tsukuba, Ibaraki)

The Aerological Observatory conducts comprehensive observation of the upper atmosphere using captive balloons, radiosondes and other instruments. It also observes the ozone layer and solar radiation, including the harmful ultraviolet type. The Observatory functions as a technical center for studies on the upper atmosphere and for the development and improvement of technologies related to upper-air observation.

Magnetic Observatory (in Ishioka, Ibaraki)

The Magnetic Observatory (also known as Kakioka Magnetic Observatory) monitors electromagnetic conditions in and around the earth. It provides geomagnetic data for monitoring of the solar-terrestrial environment and for investigations on volcanic eruptions and earthquakes. The Observatory serves as one of the standard observation stations for geomagnetism accredited by the International Union of Geodesy and Geophysics (IUGG).

Meteorological College (in Kashiwa, Chiba)

The Meteorological College is a JMA training institute offering four-year college courses and various training programs. On the four-year course, a total of around 60 students are educated in meteorology as well as basic science and geophysics. Graduates of the College go on to work for JMA as professional staff members. The training programs comprise a number of short-term courses on weather forecasting, seismology/volcanology and marine meteorology, and are aimed at improving the technical capabilities of JMA staff members.

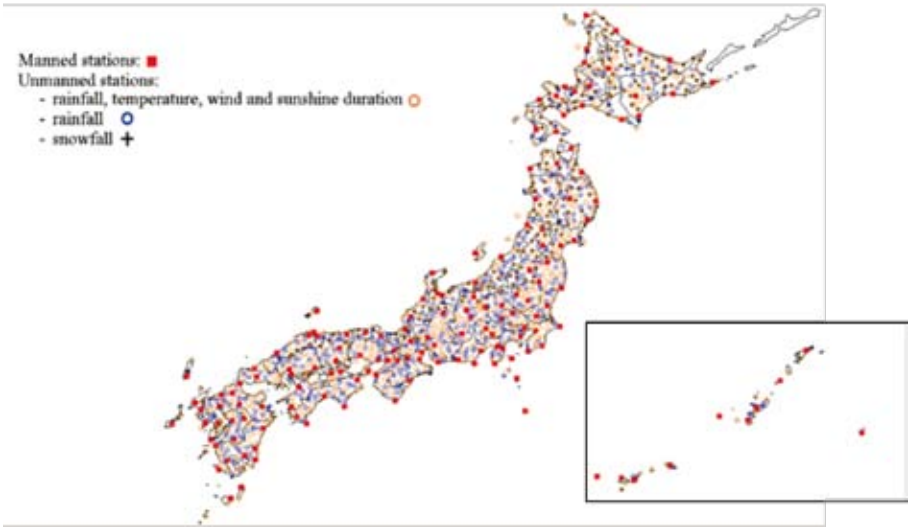
3 Observation

JMA operates an array of observation networks to monitor weather, climate and the environment around the clock on a nationwide scale.

3-1 Surface Observation

Surface observation is carried out at about 1,300 stations using automatic observation equipment collectively known as the Automated Meteorological Data Acquisition System (AMeDAS). Stations are laid out at average intervals of 17 km throughout the country, with about 1,200 of them unmanned.

Observation at manned stations covers weather, wind direction/speed, amount of precipitation, type and base height of cloud, visibility, air temperature, humidity and atmospheric pressure. Data other than those relating to weather, visibility and cloud-related elements are automatically sent every ten seconds from manned stations and some unmanned stations, and every ten minutes from the remaining unmanned stations, of which about 700 observe four elements (precipitation, air temperature, wind direction/speed and sunshine duration) and about 300 observe precipitation. In addition to these elements, snow depth is also observed at stations in areas of heavy snowfall.



Observational sites of AMeDAS

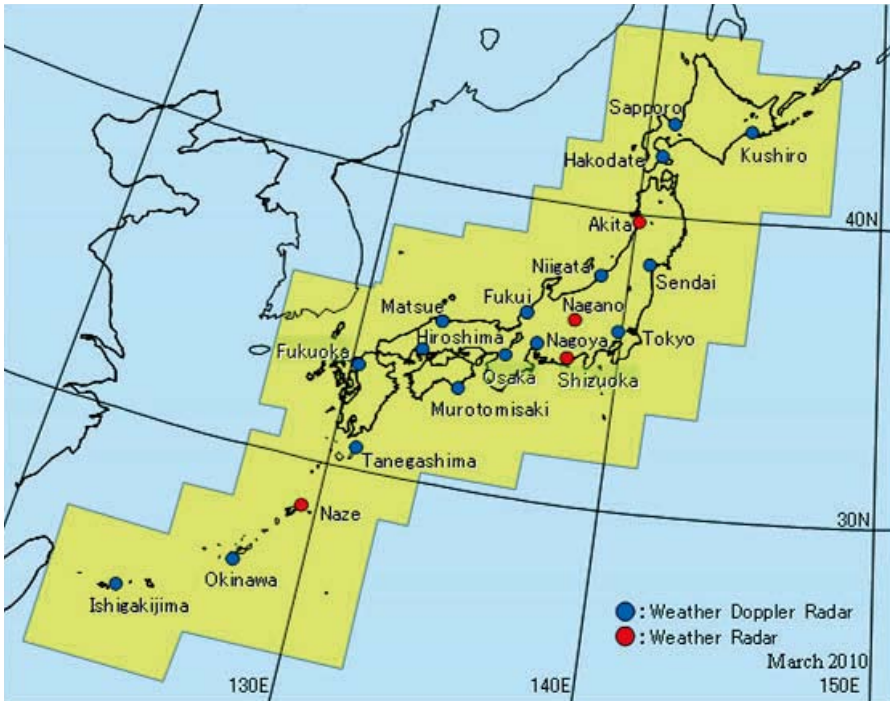
All observational data are transmitted to JMA Headquarters via dedicated lines.

3-2 Radar Observation

JMA's network of 20 C-band radars (with a wavelength of 5.6 cm) covers most of Japan's territory and observes rainfall intensity and distribution.

Radar data are digitized to produce special radar-echo composite maps every five minutes for the purpose of monitoring precipitation throughout the country. The data are also calibrated with AMeDAS in-situ data and rain gauge data from related authorities for use as initial values in Very Short-Range Forecasting of Precipitation (see page 14).

JMA has been replacing its radars with Doppler units that can measure not only precipitation intensity but also the radial velocity of raindrops. As of the end of March 2010, 16 out of the 20 units in the network had been replaced with Doppler radars.



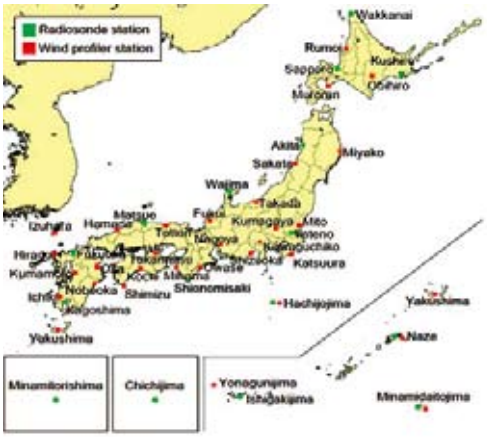
JMA Radar Observation Network

3-3 Upper-air Observation

Upper-air observation is performed through two different networks: the radiosonde observation network (16 stations) and the wind profiler observation network (31 stations).

The radiosonde (a balloon-borne instrument platform with a radio-transmitting device) covers the upper air up to a maximum of 30 km from the surface, measuring temperature, pressure, humidity and wind. Radiosonde observation is carried out twice a day at 0000 and 1200 UTC, and JMA's research vessel occasionally performs such observation in the western North Pacific and the seas adjacent to Japan.

The wind profiler – a ground-based multiple-beam Doppler radar unit – covers a range up to 5 km from the surface and automatically measures wind every ten minutes. The observed data are collected at JMA Headquarters on a real-time basis.



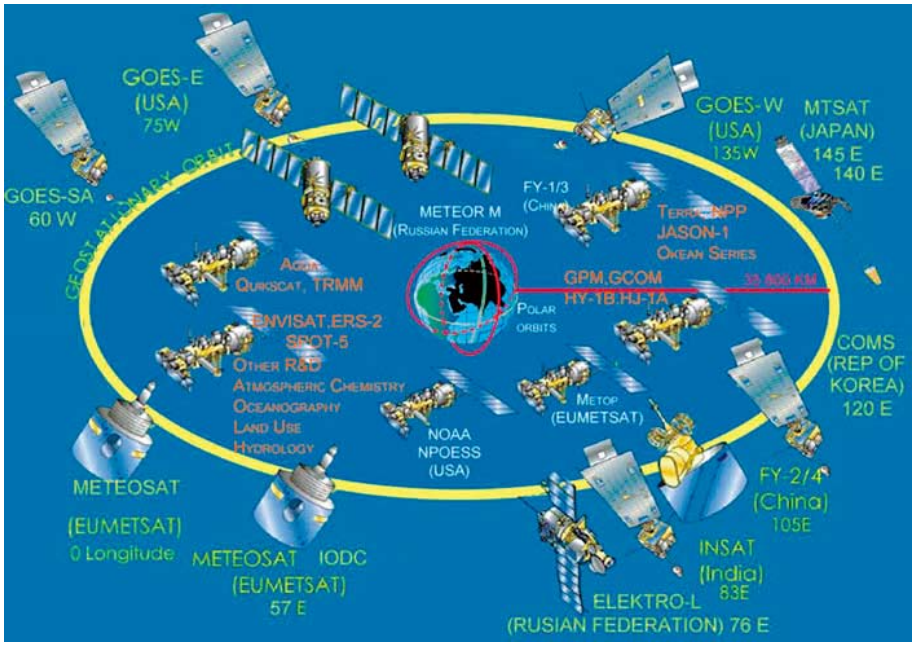
JMA Upper-air Observation

3-4 Satellite Observation

In 1977, Japan launched the first geostationary meteorological satellite (GMS) into geostationary orbit (about 36,000 km above the equator at a longitude of 140 degrees east) mainly to cover the western Pacific and East Asia as part of a space-based component of the Global Observation System (GOS) under the WMO World Weather Watch (WWW) programme. Since then, continuous efforts have been made to maintain and enhance the observational capabilities of meteorological satellites.

Satellite observation provides a wealth of information, including data on cloud height and distribution, upper-air wind, and sea surface temperature distribution. The observational data received from the spacecraft allow JMA and other National Meteorological and Hydrological Services (NMHSs) to continuously monitor significant meteorological phenomena such as typhoons, fronts and low-pressure systems. The data are also directly assimilated into the numerical weather prediction system (see chapter 5), which in turn contributes to the timely issuance of disaster prevention information and weather forecasts from JMA and NMHSs.

Currently, the Multi-functional Transport Satellite (MTSAT-1R) launched in 2005 is in operation, performing observation every 30 minutes with imaging channels consisting of a visible band and four infrared bands. MTSAT-2 (launched in 2006 and currently in a state of standby in geostationary orbit) is scheduled to take over the imaging functions of MTSAT-1R in summer 2010. MTSAT-2 has the same imaging channels as MTSAT-1R, and will provide similar observation data. Along with information from MTSAT, JMA utilizes data from various polar orbiting satellites such as the NOAA series operated by the US, Metop operated by Europe, and earth observation satellites such as TRMM and AQUA. Data from these satellites are indispensable in observing typhoons, monitoring the global and marine environment and producing initial fields for numerical weather prediction.



Current and planned space-based component of the Global Observation System (picture from the WMO website)

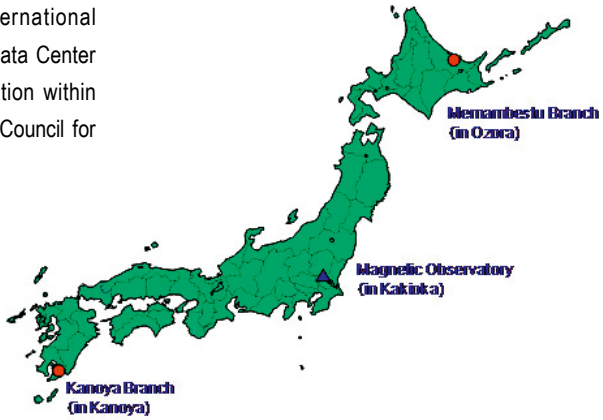
3-5 Lightning Monitoring

The lightning monitoring system pinpoints the time and location of lightning occurrences by detecting radio waves caused by lightning flashes. Data from individual detectors located at 30 airports are gathered and processed by the Data Processing Center at JMA. The results are delivered immediately to airlines for purposes such as securing ground operations at airports and managing aircraft in Japan's airspace.

3-6 Geomagnetic Observation

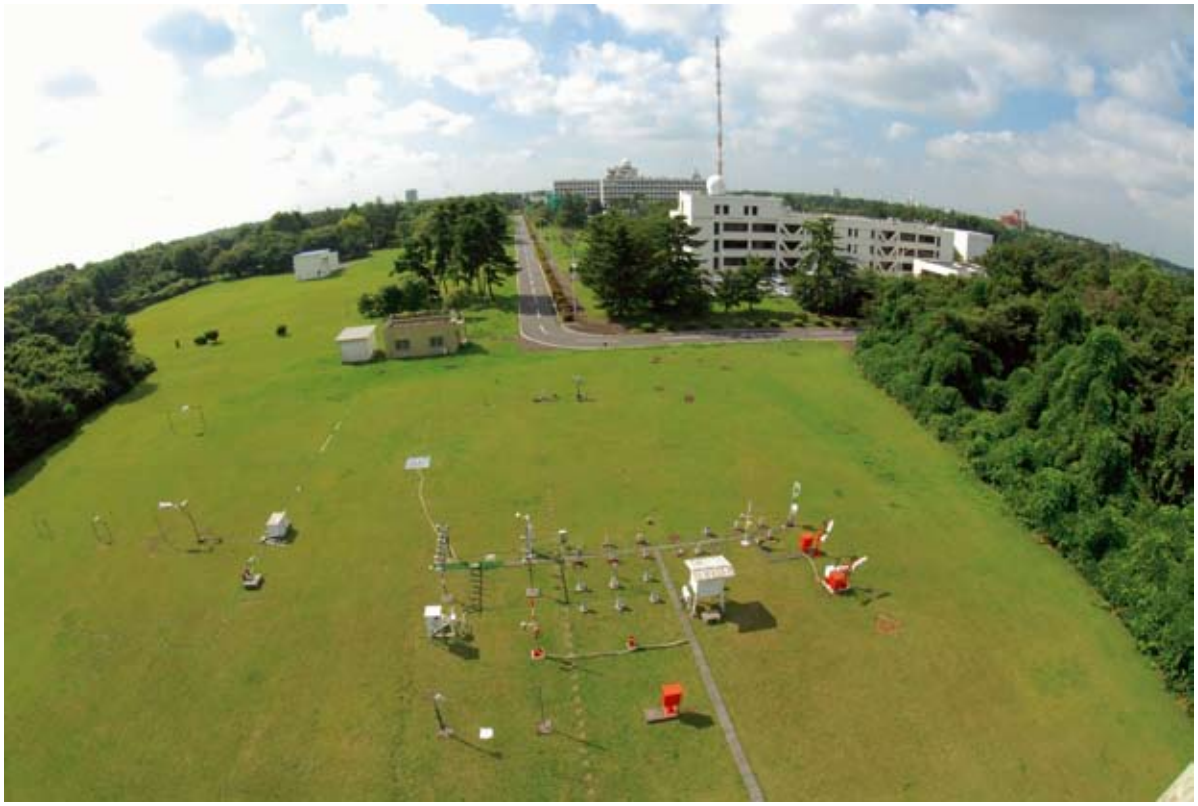
Geomagnetic observation is carried out around the clock by the Magnetic Observatory in Ishioka and its two branch offices in Ozora and Kanoya.

The results of observation are distributed not only to the relevant domestic institutes and laboratories but also to international organizations such as the World Data Center for Geomagnetism – an organization within the framework of the International Council for Science (ICSU).



3-7 Utilization of Observational Data Obtained Through Relevant Authorities

In addition to the aforementioned comprehensive observation network operated by JMA itself, the Agency also actively exchanges meteorological observational data with relevant central governmental and local authorities on a real-time basis. The integrated usage of such rain-gauge and radar data with those of JMA plays a vital role in the forecasting of torrential rain.



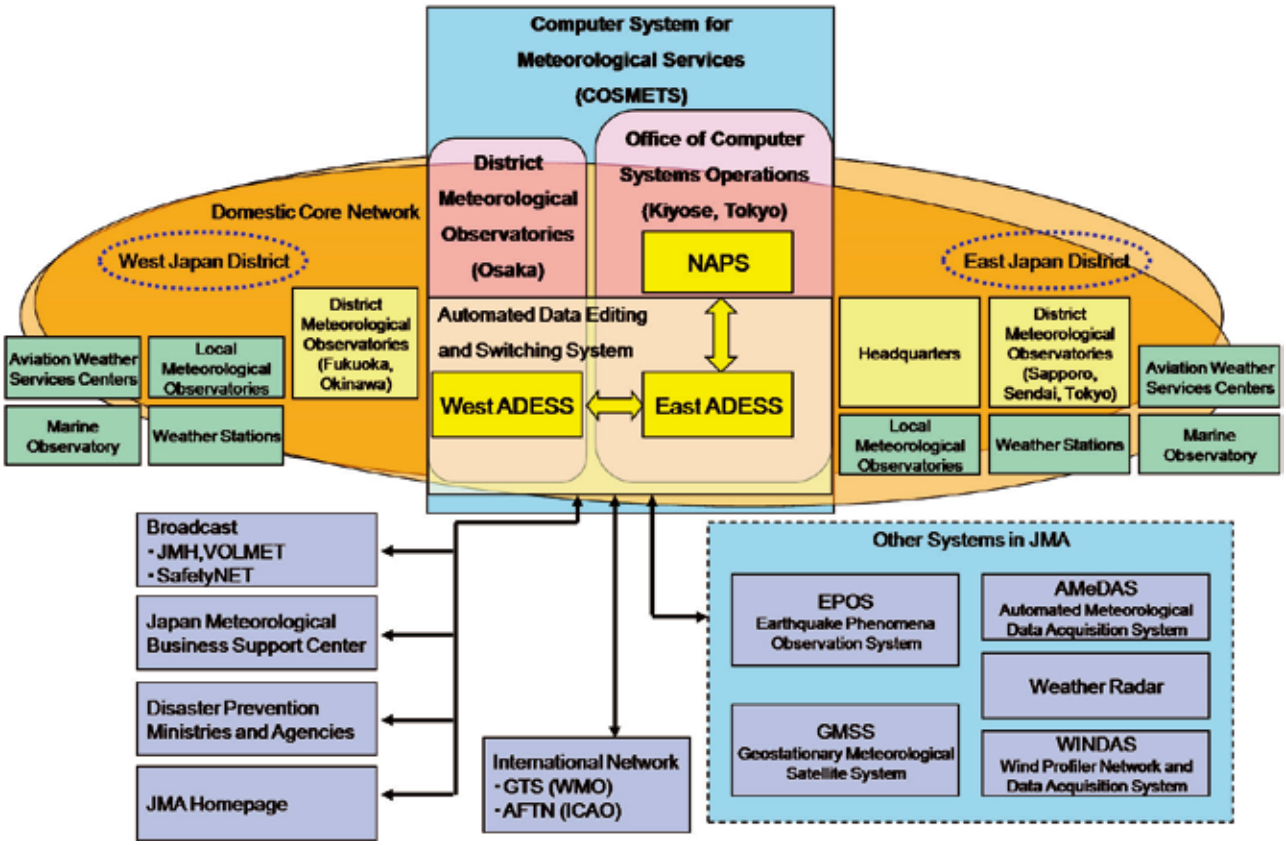
4 Telecommunications and Data Processing System

To support efficient and effective weather services, high-performance telecommunications and data processing are essential. JMA maintains state-of-the-art computer systems to enable these operations.

4-1 Computer System for Meteorological Services (COSMETS)

JMA operates two major computer systems; one is the Automated Data Editing and Switching System (ADESS) for the treatment of observational data and products, and the other is the Numerical Analysis and Prediction System (NAPS). ADESS is linked to individual JMA facilities for meteorological services as well as various related authorities (including both the central government and local governments) via exclusive landlines. To complement landline-based communication, JMA installed a communication channel through the Geostationary Meteorological Satellite (MTSAT-1R) for the delivery of earthquake reports and tsunami warnings due to the urgency and level of reliability required in disseminating such bulletins. NAPS is a super-computer system used for the computation of numerical weather predictions.

To cope with constantly increasing demand for computing performance and capacity, JMA updates NAPS with the latest high-performance computer every five years, and the most recent replacement was conducted in March 2006. ADESS and NAPS are collectively called the Computer System for Meteorological Services (COSMETS), and constitute a comprehensive system for data communication and processing.

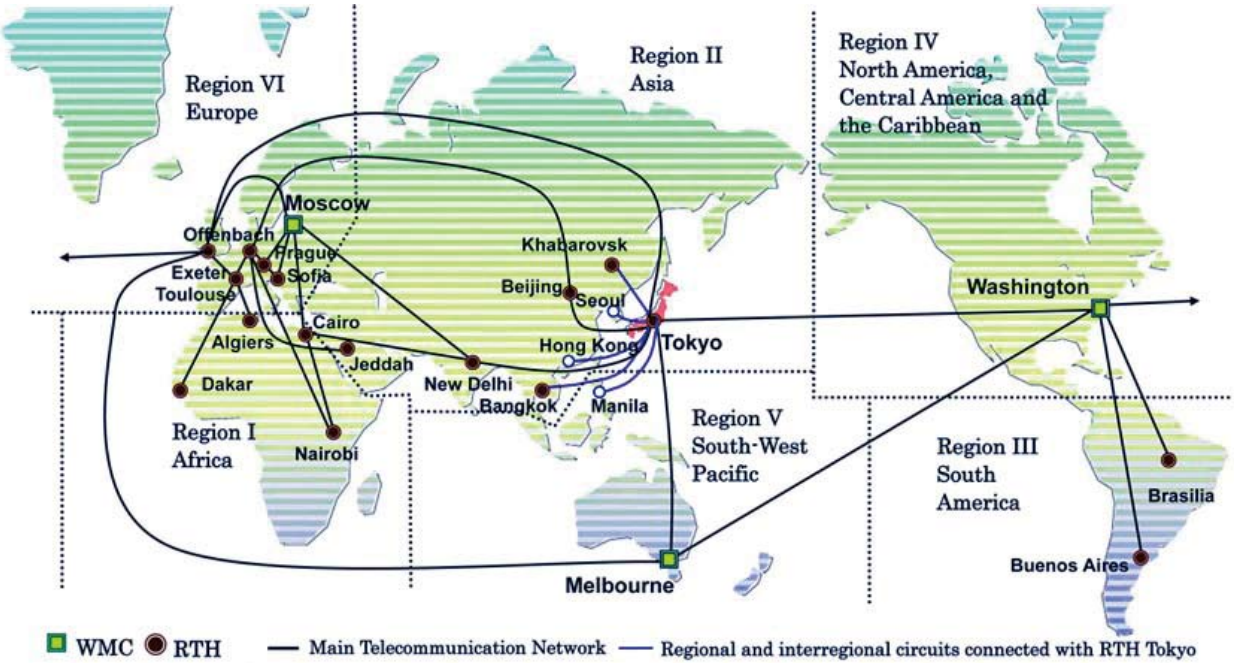


COSMETS and related systems

4-2 International Communications System

In addition to its role in domestic meteorological telecommunications, ADESS also exchanges observational data and weather-related products with National Meteorological and Hydrological Services (NMHSs) through the Global Telecommunication System (GTS), which is run under the WMO World Weather Watch (WWW) Programme. JMA serves as one of the Regional Telecommunication Hubs (RTHs) for the GTS Main Telecommunication Network, and is connected to two World Meteorological Centres (WMCs) in Washington and Melbourne, five RTHs in Beijing, Exeter, New Delhi, Bangkok and Khabarovsk, and three National Meteorological Centres (NMCs) in Seoul, Hong Kong and Manila.

As well as data exchange via the GTS, JMA operates the Regional Specialized Meteorological Center (RSMC) Data Serving System (DSS) to provide products related to numerical weather prediction (NWP) and observational data to NMHSs via the Internet.



Schematic overview of the Global Telecommunication System (GTS)

5 Numerical Weather Prediction Activities

JMA has been actively developing numerical weather prediction (NWP) systems since the commencement of operational numerical prediction in 1959 as a pioneer among National Meteorological Services. Nowadays, as one of the world's most advanced centers for NWP, JMA provides a variety of NWP products that play a vital role in weather services both on a national and an international level.

5-1 Numerical Weather Prediction Modeling and its Applications

Currently, JMA operates the following NWP models:

(1) The Global Spectral Model (GSM) for short- and medium-range forecasts up to nine days ahead covering the entire globe

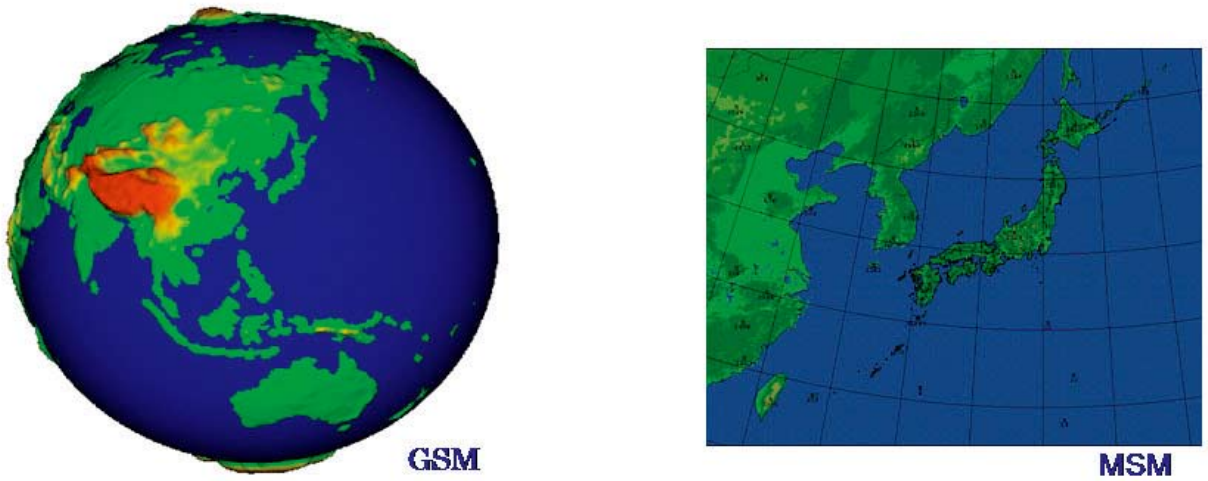
(2) The Mesoscale Model (MSM) for warnings and very-short-range forecasts covering Japan and its surrounding areas

(3) A low-resolution version of the GSM for ensemble prediction in one-week forecasting, typhoon track forecasting and one-month forecasting

(4) An atmosphere-ocean coupled model for ensemble prediction in long-range forecasting up to six months ahead and the El Niño outlook

(5) Other NWP models for specific targets such as ocean waves and sea ice extent

The Agency also applies NWP models to environmental issues regarding the atmosphere. As an example, under the framework of the WMO Environmental Emergency Response (EER) Programme, JMA serves as one of the Regional Specialized Meteorological Centers (RSMCs) for EER activities in Asia. The Center provides individual National Meteorological and Hydrological Services (NMHSs) with outlooks on the diffusion of hazardous materials based on the Atmospheric Transport Model operated by JMA in the event of the accidental release of such materials from nuclear facilities.



Domains and topography of JMA's NWP models

	Global Model (GSM)	Mesoscale Model (MSM)	Typhoon Ensemble Model	One-week Ensemble Model	One-month Ensemble Model	Seasonal Ensemble Model
Purposes	Short- and medium-range forecast	Very- short-range forecast	Typhoon track forecast	One-week forecast	One-month forecast	Three-month, Warm/Cold season and El Niño outlooks
Forecast domain	Globe	Japan and its surrounding areas	Globe			
Grid size / Number of grids	0.1875 deg. (TL959)	5 km / 721 x 577	0.5625 deg. (TL319)		1.125 deg. (TL159)	Atmosphere 1.875 deg. (TL95) Ocean 0.3 - 1.0 x 1.0 deg
Vertical levels / Top	60 / 0.1 hPa	50/21800 m	60 / 0.1 hPa			Atmosphere 40 / 0.4 hPa Ocean 50 layers
Forecast hours (Initial time)	84 hours (00, 06, 18 UTC) 216 hours (12 UTC)	15 hours (00, 06, 12, 18 UTC) 33 hours (03, 09, 15, 21 UTC)	5.5 days (00, 06, 12, 18 UTC) 11 members	9 days (12 UTC) 51 members	34 days (12 UTC; Once a week) Totally 50 members	210 days (00 UTC; Once a month) Totally 51 members
Analysis	4D-Var		Global analysis with ensemble perturbations			

Specifications of JMA's NWP models

5-2 Recent Progress in NWP

Global Model

In 2007, the horizontal resolution was improved from 60 km to 20 km for the GSM and from 110 km to 60 km for the One-week Forecast Model. For both models, the number of vertical layers was increased from 40 to 60. In 2008, the Typhoon Ensemble Forecast Model was put into operation.

Non-hydrostatic version of 4D-Var data assimilation for the MSM

The four-dimensional variational (4D-Var) data assimilation method used for analysis of the atmospheric state in the MSM was upgraded from a hydrostatic to a non-hydrostatic version in 2009.

Coupled Model

In 2010, the atmosphere-ocean coupled model was introduced in the ensemble forecasting system for long-range forecast. The model had already been used for the El Niño outlook.

6 Forecasting Services

Forecasting encompasses a wide range of meteorological information such as warnings and advisories in addition to forecasts themselves. Its objective is to meet the comprehensive need to protect life and property and to enhance national socio-economic activity in various groups including the general public, industry and the transportation sector.

6-1 Information for Severe Weather Preparedness

Warning, Advisory and Bulletin Services for Severe Weather

If hazardous weather conditions are expected, JMA delivers a variety of plain messages including warnings, advisories and bulletins to the general public and disaster prevention authorities so that appropriate measures can be taken to mitigate possible hazards. These messages are issued by Local Meteorological Observatories (LMOs) to their respective prefectures. Warnings for each municipality in the prefecture are issued when weather conditions are expected to be catastrophic and meet the warning criteria, while advisories are issued when conditions are expected to be disastrous and meet advisory criteria but remain below the warning criteria.

Bulletins provide information to supplement warnings and advisories. They are also issued by District Meteorological Observatories (DMO) or JMA Headquarters according to the scale or severity of the related disturbance, and include information not only on severe weather but also on possible disasters. For example, sediment disaster bulletins are issued jointly with municipalities in particular when sediment-related disasters caused by heavy rain are expected with a high possibility in the next few hours.

Serious damage caused by severe storms including tornadoes in 2006 induced requirements for alerts for hazardous winds. To address this requirement, JMA started to issue the "Tornado Watch" from March 2008 and will issue "Hazardous Wind Nowcast" from 2010, based on the discussion in advisory meetings.

All such information is delivered to the public through the media and directly to disaster prevention authorities from JMA Headquarters and/or DMOs.

Warnings

Storm	Snow-storm	Heavy rain	Heavy snow
Storm surge	High waves	Flood	

Advisories

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	Flood

Meteorological warnings/advisories issued by JMA

Flood Warning and Advisory Services in Collaboration with River Management Authorities

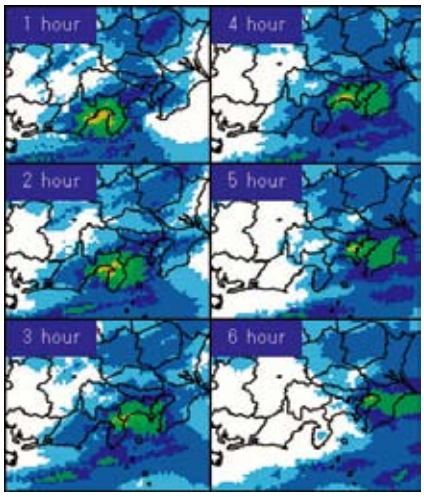
JMA is also responsible for providing flood forecasting services, which are performed in collaboration with central and local government agencies. These services include flood warnings and advisories covering 366 rivers (as of September 2009) throughout the country that have been designated by the aforementioned agencies as potential flood-disaster rivers. Flood forecasting systems for 259 rivers out of 366 are managed jointly by JMA and the River Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and 107 jointly by JMA and civil engineering bureaus of prefectural governments.

6-2 Weather Forecasts

Very Short-range Forecasting of Precipitation and Precipitation Nowcast

A Very Short-range Forecast of Precipitation is issued twice an hour to predict one-hour precipitation amounts for the next six hours with a spatial resolution of 1 km. This forecast is derived from a combination of Mesoscale Model (MSM) predictions and the extrapolation of Radar/Raingauge-Analyzed Precipitation data, which is radar-observed precipitation calibrated with the in-situ rain gauges of AMeDAS, the River Bureau, the Road Bureau and local governments.

The Precipitation Nowcast provides 10-minute precipitation forecasts with a spatial resolution of 1 km up to one hour ahead for disaster prevention activities in the event of swiftly growing convections. It is issued every 10 minutes within 3 minutes of every 10-minute radar observation.

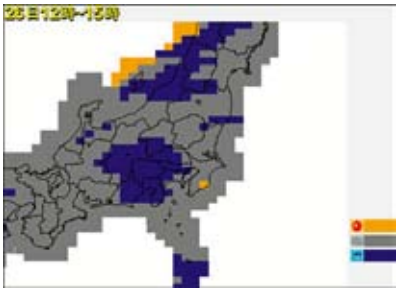


Very Short-range Forecast of Precipitation

Forecast up to Two Days ahead

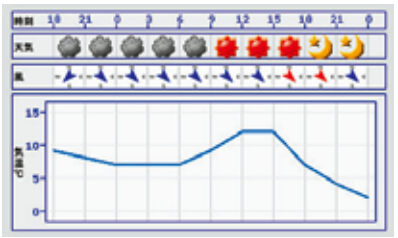
Daily forecasts in plain text form for the same day, the next day and the day after are issued three times a day at 0500, 1100 and 1700 Japan Standard Time (JST) for a total of 142 forecast blocks across the country. These daily forecasts contain information about weather, winds, coastal ocean waves, maximum/minimum temperatures and probabilities of precipitation.

Daily Forecast



Area Distribution Forecast

In addition to forecasts in plain text, JMA also provides versions in graphic form such as Area Distribution Forecasts and Time Sequence Forecasts. Area Distribution Forecasts show the spatial distribution of weather, precipitation and maximum/minimum temperatures for the whole country with a spatial resolution of 20 km x 20 km.



Time Sequence Forecast

Time Sequence Forecasts predict weather, temperature and wind speed/direction at three-hour intervals for 142 forecast blocks across the country. Both forecasts are issued at the same time as daily forecasts.

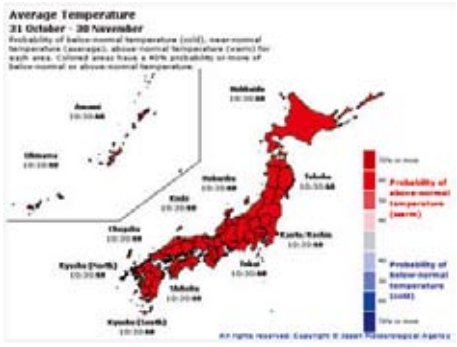
One-week Forecast

One-week Forecasts cover a seven-day period starting from the day after the forecast is issued. They are put out daily at 1100 and 1700 JST to provide day-to-day forecasts of weather, precipitation probability, maximum/minimum temperatures and reliability for 59 prefectural areas of the country. Ensemble prediction techniques are employed as the main basis of the One-week Forecast, and have contributed much to the improvement of its accuracy.

Other Short-range Forecast Services

Fire Weather Alerts are issued to prefectural authorities to support their firefighting efforts when meteorological conditions such as low relative humidity and strong winds raise the risk of fire. Photo-chemical Smog Bulletins are appropriate bases for prefectural governments to announce photo-chemical smog warnings. These bulletins provide an outlook on the concentration of photochemical oxidants in the air for the same day or the following day.

Long-range Forecast



In Long-range Forecasts, weather outlooks for the next one to several months are provided. These outlooks offer a prognosis on average temperature, precipitation, sunshine and snowfall in the three categories of above normal, near normal and below normal. Ensemble prediction techniques play an increasingly important role in long-range forecasting. Early Warning Information on Extreme Weather is issued every Tuesday and Friday when a high probability (30% or more) of very high or very low seven-day average temperatures is predicted in the week starting from five to eight days ahead of the date of announcement.

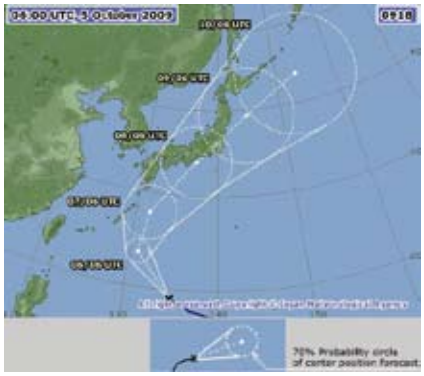
6-3 Typhoon Analysis and Forecast

Tropical cyclones (TCs) can cause serious damage to various countries every year, and accurately predicting their locations and intensities is a vital challenge for JMA. The Agency categorizes TCs as shown in the following table.

JMA monitors TC activity in the western North Pacific and the South China Sea, and issues TC advisories every three hours to provide related information including analysis and forecasting of location, intensity and movement up to three days ahead. When a TC moves onshore or is in the vicinity of Japan and is expected to have an impact on the country, analysis is issued every hour in order to advise the public of possible impending disasters. JMA also started issuing five-day track forecasts in 2009 based mainly on its Typhoon Ensemble Prediction System. To assist local governments in their disaster prevention activities, information on the three-hourly probability of winds measuring 50 knots or greater is issued when the likelihood is expected to exceed 0.5 percent within three days from each of 375 subdivisions all over the country.

Max wind speed	Categorization in Japan	International categorization
- 33 kt	Tropical Depression	Tropical Depression
34 - 47 kt	Taifu	Tropical Storm
48 - 63 kt	Taifu	Severe Tropical Storm
64 - 84 kt	Taifu (strong)	Typhoon
85 - 104 kt	Taifu (very strong)	Typhoon
105 kt -	Taifu (violent)	Typhoon

Categorization of TCs in the western North Pacific



Five-day track forecast

6-4 Dissemination of Forecasts and Warnings

For the dissemination of forecasts and warnings, JMA maintains a telephone auto-answering service for the public and direct communication links between meteorological offices and central/local governments as well as the media. The Agency also actively introduces new information technologies into its meteorological information services. One example of this is the high-speed communications network called the Information Network for Disaster Prevention (INDiP), which enables effective and rapid dissemination of information in both text and graphic form. INDiP connects individual LMOs/DMOs with JMA Headquarters to complement the traditionally established communication network for more user-friendly tailored provision of meteorological information – in particular warnings and advisories – directly and individually to disaster prevention authorities in individual prefectures, towns/cities and the media.

Information for maritime users is transmitted by the JMA radio facsimile broadcast (JMH) service operated by JMA and fishery radio communications. It is also disseminated within the framework of the Global Maritime Distress and Safety System (GMDSS), i.e. via the NAVTEX broadcast service of the Japan Coast Guard for seas in the vicinity of Japan, and via the Safety-Net broadcast service for ships in the high seas through the maritime satellite INMARSAT.

Nowadays, the Internet plays a vital role for JMA in the dissemination of wide-ranging meteorological information not only on forecasts but also on historical and current observational data – including those of other organizations (see 3.7) – to the public.

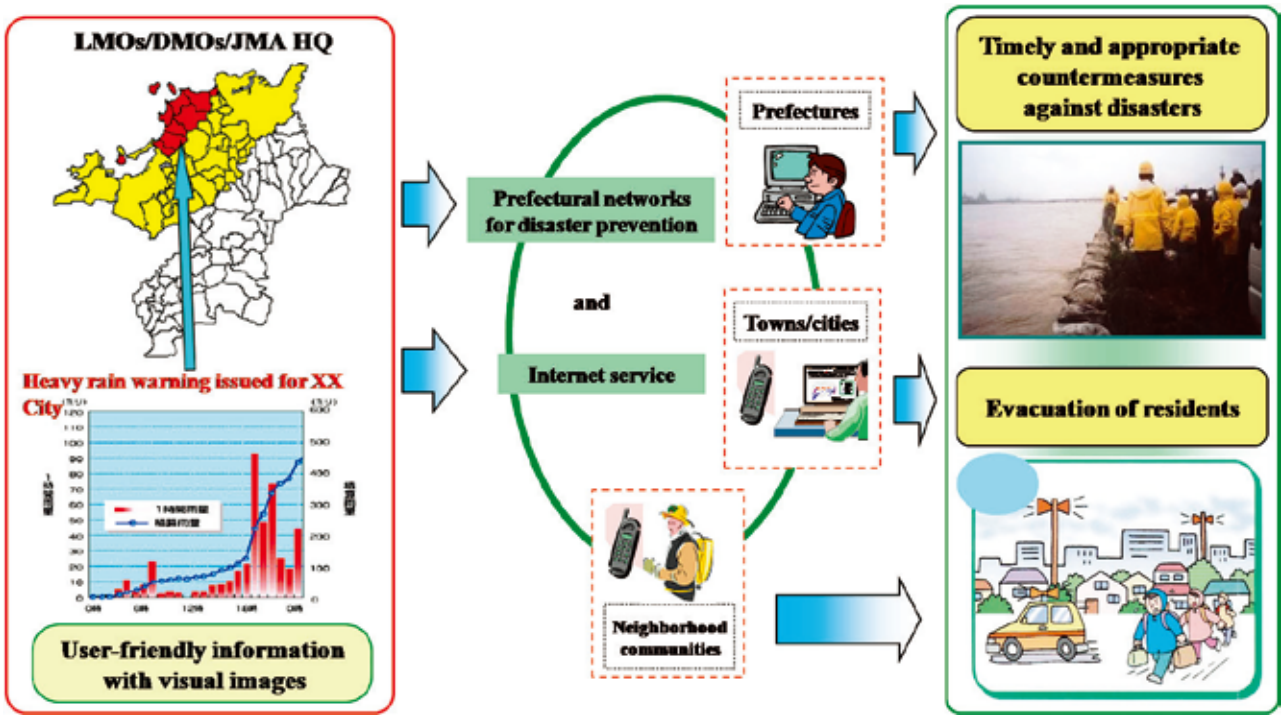


Image of information flow to users through INDiP

7 Aviation/Marine Weather Services

To secure the safety, regularity and efficiency of domestic and international aviation operations in Japan, JMA provides aviation weather services for airlines and the air traffic control authority – the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) – and National Meteorological Services around the world.

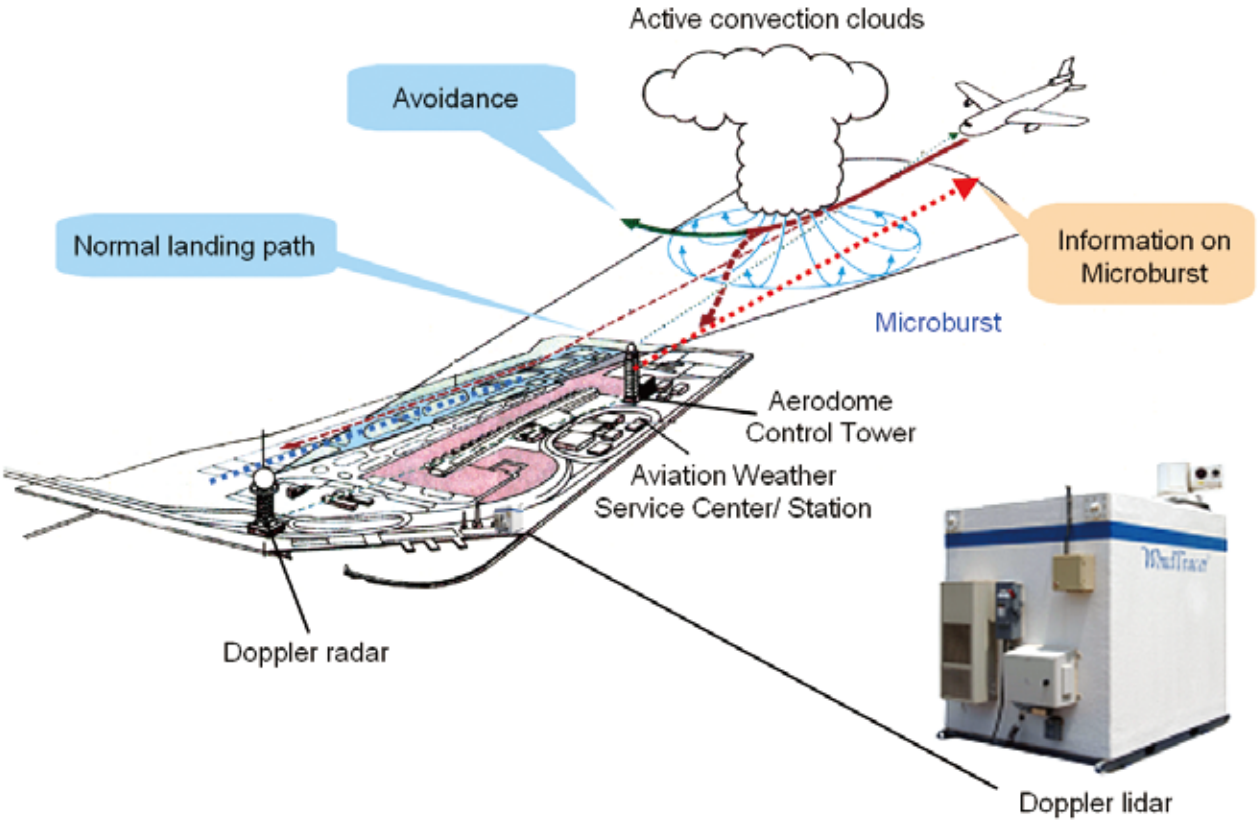
7-1 Aeronautical Meteorological Observations

Aviation weather offices observe not only basic meteorological elements but also specific ones that are critical for aviation operations, such as runway visual range and cloud ceiling height. Particular attention is paid to severe weather conditions that seriously affect aviation operations.

Lightning, for example, is continuously observed using a monitoring system composed of lightning detectors installed at 30 airports across the country.

Rainfall is monitored by Doppler radars at nine airports. These units are also capable of observing three-dimensional wind fields to detect low-level wind shear, which is often hazardous to aircraft during takeoff and landing in conditions of precipitation. When there is no precipitation, three-dimensional wind fields are observed using Doppler lidars at two airports.

Information on wind shear is passed on to pilots through the air traffic control authority in real time so that they can take immediate action to evade hazardous conditions.



Doppler radar and Doppler lidar for airport weather observation

7-2 Aviation Weather Forecasts and Warnings

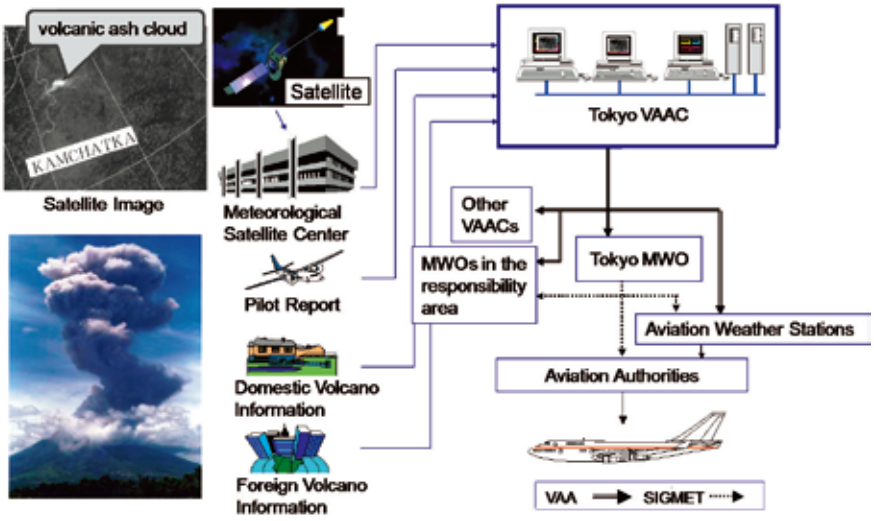
JMA provides forecasts, warnings and bulletins on weather conditions at airports as well as information on en-route weather conditions for cruising aircraft.

At 35 major airports, aerodrome forecasts for up to 27 hours ahead are issued every 6 hours. If severe weather is expected, aerodrome weather bulletins and/or warnings are also issued.

SIGMET information is issued to provide advice on weather phenomena that can be hazardous to aircraft in flight (such as turbulence and thunderstorms) to the Fukuoka Flight Information Region (FIR) for international flights.

7-3 Volcanic Ash Advisory

Clouds of volcanic ash ejected by active volcanoes contain hazardous materials, which can seriously hinder airplane engine operation. In its role as the Tokyo Volcanic Ash Advisory Center (VAAC) as designated by the International Civil Aviation Organization (ICAO) in cooperation with WMO, JMA provides Volcanic Ash Advisories (VAAs) detailing the current status and forecasts of volcanic ash clouds for East Asia and the western North Pacific.



Flow of Volcanic Ash Advisory

7-4 Other Aviation Meteorological Services

Tokyo VOLMET broadcast

For aircraft in flight in the Pacific region, JMA disseminates weather reports for six major international airports in Japan as well as for Incheon International Airport (Republic of Korea) via Tokyo VOLMET, a short-wave radio broadcasting service.

Tokyo OPMET Data Bank

The Tokyo Operational Meteorological (OPMET) Data Bank collects and archives aviation weather reports from the Asia-Pacific region. The resource allows aeronautical users to access stored reports through the Aeronautical Fixed Telecommunications Network (AFTN) – a dedicated aeronautical communications network connecting National Aviation Bureaus and National Meteorological Services.

7-5 Communication of Aviation-related Meteorological Information

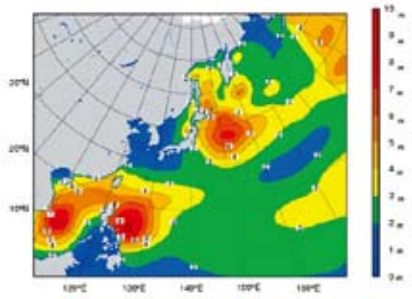
Observational meteorological reports and aerodrome forecasts issued by Aviation Weather Stations (AWSs) along with various aeronautical weather charts produced by JMA Headquarters are distributed to airport traffic control units of the Civil Aviation Bureau (CAB) and airlines. The aerodrome meteorological information network is utilized for this dissemination. Observational reports and aerodrome forecasts are also provided to aircraft in flight through Tokyo VOLMET broadcasting and air-ground CAB communications. Meanwhile, information on significant weather conditions encountered by pilots in flight (turbulence in particular) is transmitted to JMA via air traffic controllers and relayed to airlines. Aeronautical meteorological bulletins are also exchanged internationally through the AFTN.

Air Traffic Meteorology Center

JMA's Air Traffic Meteorology Center (ATMetC), established in Oct. 2005, supports the Air Traffic Management Center (ATMC) of the Japan Civil Aviation Bureau (JCAB). JCAB's ATMC service is designed to ensure the smooth and flexible use of airspace and promote its efficient use in order to contribute to the systematization of flight routes in the Fukuoka Flight Information Region. Significant weather events affect the air traffic network, so ATMetC provides the timely meteorological information needed by ATMC controllers and related parties. ATMetC staff support ATMC's operations by working together in the same operation room, thereby contributing to the safe and smooth operation of aviation traffic in Japan.

Air Traffic Meteorology Center (Fukuoka) At the ATMC, ATMetC staff work together with ATMC staff in a single operations room.

7-6 Marine Forecasts and Warnings



Oceanic wave forecast

Marine meteorological forecasts and warnings such as those for gales, storms, typhoons and fog are provided for the safety and efficiency of shipping, fisheries and other offshore activities. JMA is responsible for preparing and issuing warnings and weather and sea bulletins through the international SafetyNET service under the framework of the GMDSS (Global Marine Distress and Safety System) for high seas mainly in the western North Pacific. Detailed marine safety information is provided for the sea areas around Japan through the international NAVTEX service. Graphical information (including surface weather maps and ocean wave charts) is broadcast through JMH (by radiofacsimile) for the western North Pacific. In the winter season, sea ice forecasts and bulletins are also issued for the Sea of Okhotsk.

8 Climate Change and Global Environmental Issues

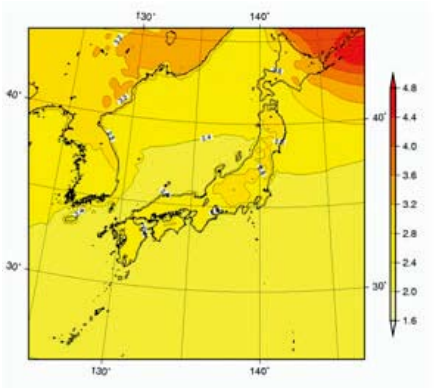
Recent years have seen growing concern over world environmental issues such as global warming, ozone layer depletion and acid rain as well as extreme weather events associated with climate change. These phenomena are expected to seriously impact socio-economic activity and the natural environment around the world. To address the related issues, JMA carries out various types of observation, monitoring and research, and provides the results to individual National Meteorological and Hydrological Services, other relevant organizations and the academic community of the world through international frameworks including WMO.

8-1 Monitoring of Climate Change and Global Warming Projection

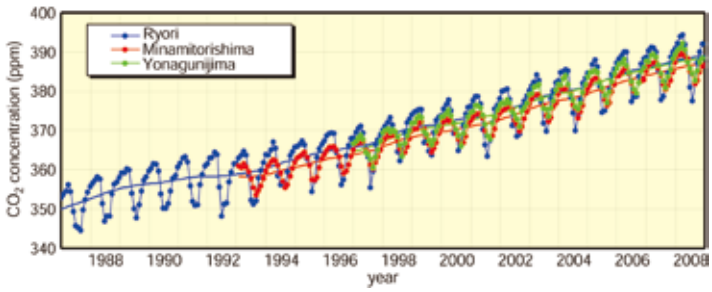
JMA contributes to the development of mitigation and adaptation measures related to climate change in various sectors through the provision of scientific information and expertise on climate change. For this purpose, JMA monitors and analyzes climatic conditions in Japan and around the world as well as greenhouse gas concentrations and global average surface temperatures.

The Agency publishes the results of numerical projections for future climate conditions obtained using a coupled atmosphere-ocean general circulation model and a regional climate model developed by its Meteorological Research Institute (MRI) to assess the effects of global warming.

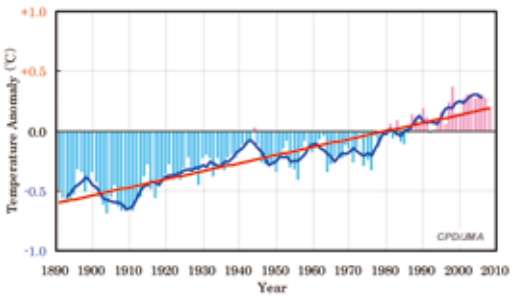
JMA contributes to international collaboration for the purpose of assessing climate change, particularly through the activities of the Intergovernmental Panel on Climate Change (IPCC), by preparing assessment reports.



Temperature projection for the end of the 21st century around Japan



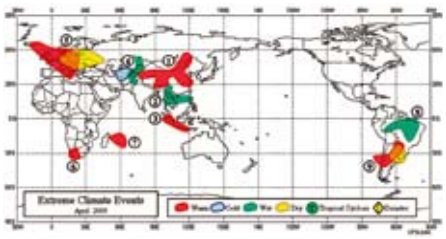
Time series of monthly mean atmospheric CO_2 concentrations observed at JMA's observatories



Long-term trend of global average surface temperature

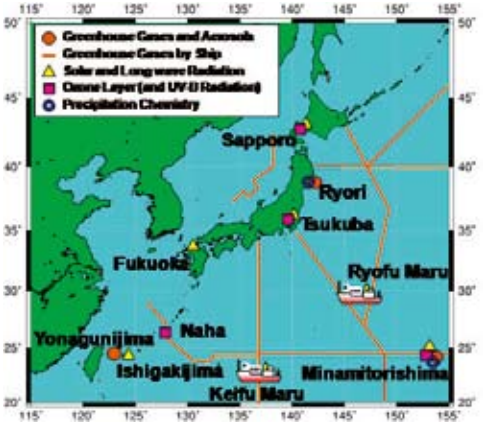
8-2 Monitoring of Climate Conditions and Extreme Weather

JMA monitors global climate data through WMO's Global Telecommunication System (GTS). It assembles quality-checked data on temperature and precipitation to assess extreme climate events, and publishes Monitoring Reports on such phenomena with brief descriptions of the resulting disastrous conditions. The Agency also monitors the present state of the global climate system. These monitoring results are useful in understanding the present climate, including extreme events and long-term trends, and in carrying out long-range forecasts and scientific research.



Distribution of Extreme Climate Events (Apr. 2009)

8-3 Observation of the Atmospheric Environment



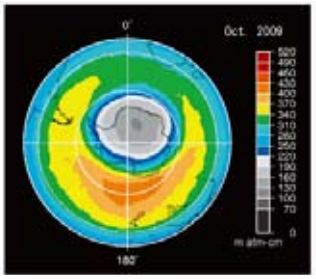
JMA carries out monitoring of greenhouse gases, ozone and other atmospheric components, and provides related information under WMO's Global Atmosphere Watch (GAW) program.

JMA operates the World Data Centre for Greenhouse Gases (WDCGG), the Quality Assurance/Science Activity Centre (QA/SAC) and the World Calibration Centre (WCC). The WDCGG collects archives and provides greenhouse gas observation data from all over the world via the Internet as part of GAW activities. The global analysis conducted by the WDCGG contributes to annual WMO Greenhouse Gas Bulletins, serving as an important scientific input to the United Nations Framework Convention on Climate Change (UNFCCC). The QA/SAC helps to improve the quality of observational data in Asia and the South-West Pacific. The WCC assists Asian countries in maintaining national standards for the observation of methane and total ozone.

Observation in Antarctica

Japan started Antarctic observation as an activity related to the International Geophysical Year (IGY) in 1957 – 1958. Since the first Japanese Antarctic Research Expedition in 1957, JMA has sent experts to Antarctica every year to conduct observation of ozone and solar radiation as well as surface and upper-air at Syowa Station. Observation conducted at this station led to the discovery of the ozone hole over Antarctica, and it still plays an important role in monitoring the global environment and climate.

Meteorological observations facilities, Syowa Station (69° 00' S 39° 35' E)



Antarctic ozone hole in October 2009 (gray area), based on NASA satellite data.

8-4 Oceanographic Observation and Information

Oceanographic and Marine Meteorological Observation

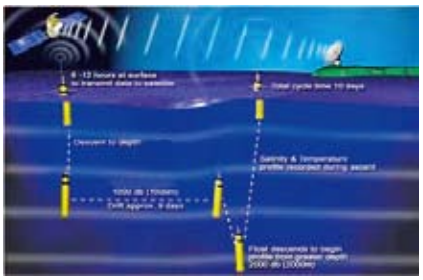
JMA conducts various kinds of oceanographic and marine meteorological observation with a view to ensuring safety and economic ship routing, preventing marine disasters and providing data for climate change monitoring. This observation is carried out using research vessels, drifting buoys, profiling floats, tidal stations, coastal wave stations and earth-observing satellites.

- Observation Using Vessels

JMA operates two research vessels in the western Pacific including the seas adjacent to Japan. These vessels mainly monitor large-scale, long-term variations in ocean environments, including global warming, in cooperation with international observation programs such as the IOCCP (International Ocean Carbon Coordination Project). Observation data from vessels are essential for accurate projection of global warming as well as analysis of current oceanic conditions. JMA also receives marine meteorological reports from merchant and fishery vessels via INMARSAT free of charge under WMO's VOS (Voluntary Observation Ship) scheme.

JMA research vessel (Ryofu Maru)

- Observation Using Buoys and Floats



Argo float

JMA deploys drifting ocean data buoys in the seas adjacent to Japan to perform autonomous observation of atmospheric pressure, sea waves and water temperature as they drift on the sea surface.

For sub-surface observation using floats, JMA participates in the Argo Project, which is conducted under WMO, UNESCO/IOC and other related institutions. As part of the project, JMA deploys profiling floats to observe water temperature and salinity from the sea surface to a water depth of 2,000 m. It also operates the Japan Argo Data Assembly Center to enable distribution of the resulting data for international exchange.

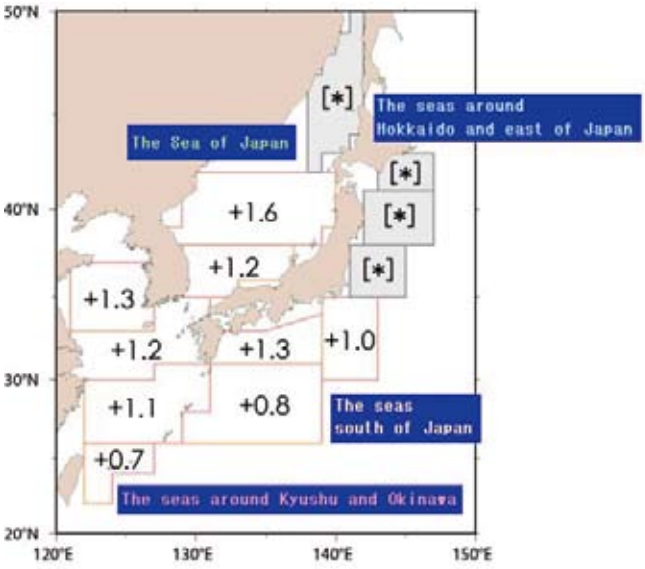
- Observation at Coastal Stations

In order to monitor unusual sea-level changes such as storm surges and tsunamis, which can cause devastating damage to coastal areas, JMA observes sea levels at tidal stations located along the coast of Japan. In addition to tidal stations, the Agency also has coastal wave stations to observe wave heights and wave periods for safe marine transport and safety management of buildings in coastal areas.ave periods for safe marine transport and safety management of buildings in coastal areas.

Oceanographic Information

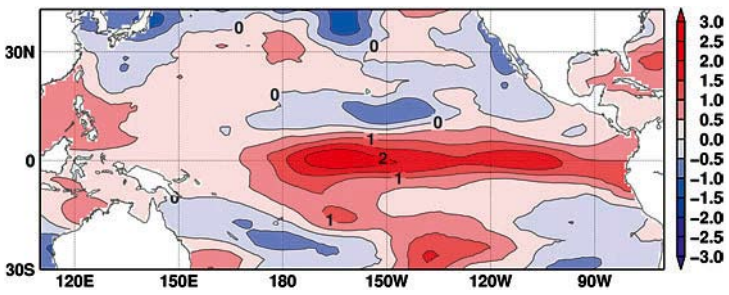
Based on the types of observation outlined above, JMA provides a variety of oceanographic information, such as data on variations and long-term trends of sea surface temperature (SST), sea current and sea-level change.

Since El Niño and La Niña events are related to climate variability in various regions of the world, JMA monitors and predicts El Niño Southern Oscillation (ENSO). Monthly diagnostic reports, including ENSO monitoring products, ENSO indices and El Niño outlooks, are published using the results.



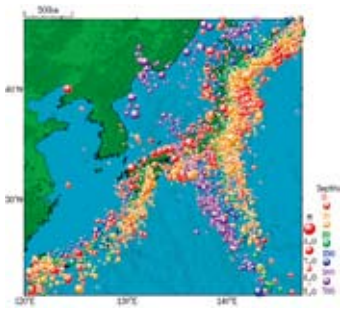
Rates of increase in the annual mean SST around Japan by area for the period 1900 to 2006 (℃/100 years).

Areas marked [*] are those where no significant value has been estimated due to large SST variability factors such as decadal oscillation.



Monthly mean sea surface temperature (SST) anomaly (°C) in November 2002 during the mature phase of the 2002 – 2003 El Niño event

9 Monitoring of Earthquakes, Tsunamis and Volcanic Activity



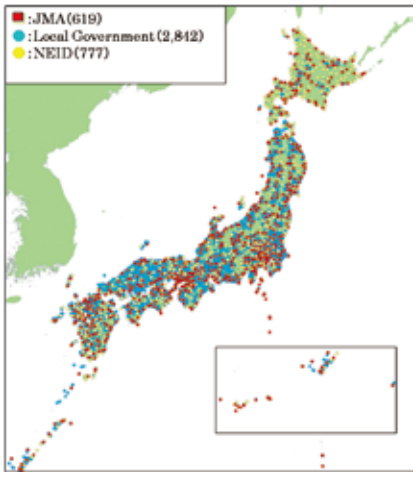
Earthquake distribution around Japan (1924-2008)

Located in one of the most active seismic and volcanic zones in the world, Japan is frequently affected by earthquakes and volcanic disasters. JMA operationally monitors seismic and volcanic activity throughout the country and issues relevant warnings and information to mitigate damage caused by disasters related to earthquakes, tsunamis and volcanic eruptions.

9-1 Monitoring of Earthquakes and Provision of Information

To monitor earthquakes, JMA operates an earthquake observation network comprised of about 200 seismographs and 600 seismic intensity meters. It also collects data from over 3,600 seismic intensity meters managed by local governments and the National Research Institute for Earth Science and Disaster Prevention (NIED). The data collected are input to the Earthquake Phenomena Observation System (EPOS) at the headquarters in Tokyo and the Osaka District Meteorological Observatory on a real-time basis.

When an earthquake occurs, JMA immediately issues information on its hypocenter, magnitude and observed seismic intensity. If the seismic intensity is 3 or greater, the Agency issues a Seismic Intensity Information report within one and a half minutes. The information is provided to disaster prevention authorities via dedicated lines, and reaches the public through local governments and the media. This information also plays a vital role as a trigger for the initiation of rescue and relief operations related to earthquake disasters.

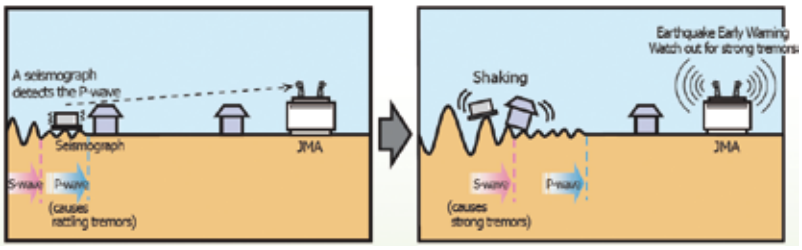


Sites of seismic intensity meters (as of January 5, 2010)

9-2 Earthquake Early Warning System

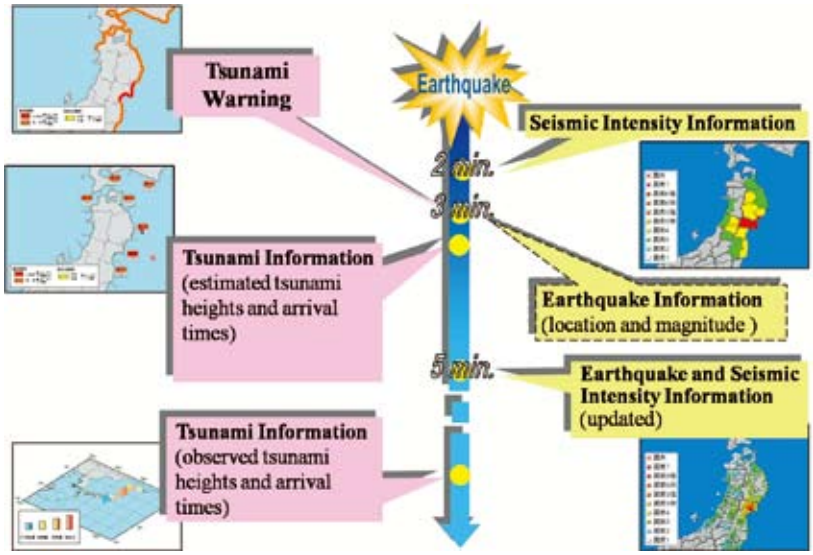
The Earthquake Early Warning system provides advance announcement of the estimated seismic intensity and expected arrival time of principal motion when an earthquake occurs. These estimations are based on prompt analysis of the quake's focus and magnitude using waveform data obtained from seismographs near the epicenter.

The Earthquake Early Warning system is aimed at mitigating earthquake-related damage by allowing countermeasures such as promptly slowing down trains, controlling elevators to avoid danger and enabling people to quickly protect themselves in various environments such as factories, offices, houses and near cliffs.



9-3 Tsunami Warnings

To reduce and mitigate catastrophic losses caused by tsunamis, immediate provision of tsunami information for coastal regions is essential. When an earthquake occurs, JMA estimates the possibility of tsunami generation from seismic observation data. If a damaging tsunami is expected in coastal regions, JMA issues a Tsunami Warning/Advisory for each region within around two to three minutes of the quake. If tsunamis are generated by seismic events far from Japan, the Agency engages in coordinated action with the Pacific Tsunami Warning Center (PTWC) in Hawaii and issues warnings for long-propagating tsunamis.

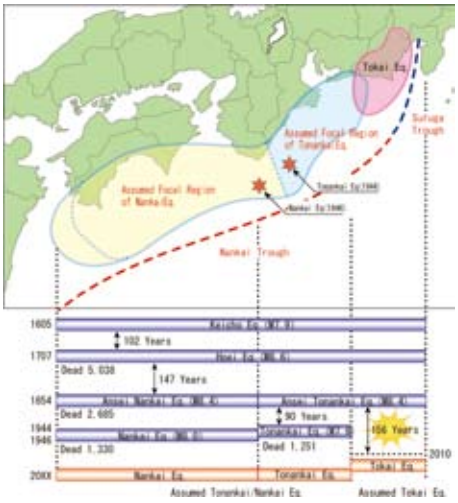


Time sequence for issuance of informati-on on tsunamis and earthquakes

9-4 Prediction and Information Services for the Tokai Earthquake

The Tokai Earthquake (predicted to be as large as magnitude 8) is expected to occur in the near future along the trench near Suruga Bay, as huge earthquakes have historically struck every 100 – 150 years along the Suruga Trough and the Nankai Trough. Generally, earthquake prediction remains at the research stage except for that regarding the Tokai Earthquake. The mechanism of this tremor is quite well understood, and observation of a pre-slip phenomenon is expected just before the earthquake itself. JMA has observation systems in place to detect this pre-slip.

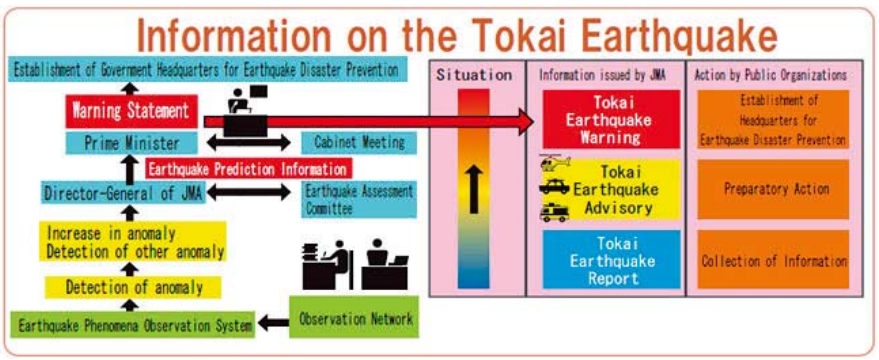
The Agency issues information on the Tokai Earthquake, including its prediction, according to the Large-Scale Earthquake Countermeasures Act. If any anomalies are detected in observational data, JMA issues



Earthquakes in the Tokai and Nankai areas from 1600

Information about the Tokai Earthquake report to enable preparatory action for disaster prevention by prefectural government headquarters. This information is categorized into three types according to the level of warning.

If any anomalous phenomena are suspected to be precursors to the Tokai Earthquake, JMA will convene the Earthquake Assessment Committee for Areas under Intensified Measures against Earthquake Disaster (consisting of leading seismologists), and will examine whether or not the anomaly is indeed a precursor. If the Committee concludes that the Tokai Earthquake is imminent, the Director-General of JMA will report this conclusion to the Prime Minister, who will then hold a Cabinet meeting and issue a warning statement.



9-5 Volcanic Disaster Mitigation

Monitoring of Volcanic Activity

There are 108 active volcanoes in Japan; on average, a total of 15 volcanic events (including eruptions) occur every year, some of which seriously hinder human life. To continuously monitor this volcanic activity, JMA deploys seismographs and related observation instruments in the vicinity of 30 volcanoes that are remarkably active. Mobile observation teams are sent to other volcanoes for regular patrols. When volcanic anomalies are detected, the Agency steps up its monitoring/observation activities and publishes volcano information and regular bulletins.

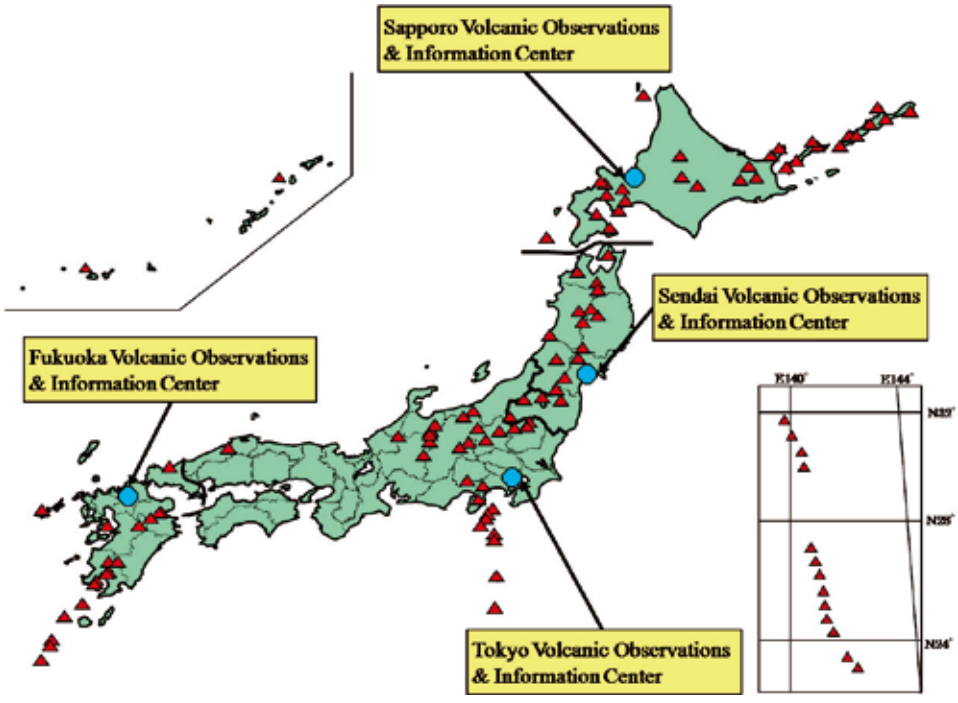
In order to detect unusual volcanic phenomena and issue volcano information appropriately, JMA operates Volcanic Observations and Information Centers at JMA Headquarters and at the Sapporo, Sendai and Fukuoka District Meteorological Observatories, which integrate various types of observation data and monitor volcanic activity in their areas of responsibility.

Volcanic Warnings and Volcanic Forecasts

JMA began issuing Volcanic Warnings and Volcanic Forecasts for each active volcano in Japan on Dec 1, 2007 to mitigate damage from volcanic activity. Volcanic Warnings are issued in relation to expected volcanic disasters, and specify the municipalities where people need to take action. Volcanic Forecasts are issued for less active volcanoes or those that become so.

Coordinating Committee for Prediction of Volcanic Eruptions

The Coordinating Committee for Prediction of Volcanic Eruptions was established in 1974 under the Volcanic Eruption Prediction Plan. The Committee is comprised of experts from the academic community and related organizations, and the secretariat is located at JMA. The group periodically reviews volcanic activity in Japan and provides outlooks on volcanic eruptions when required.



Active volcanoes in Japan

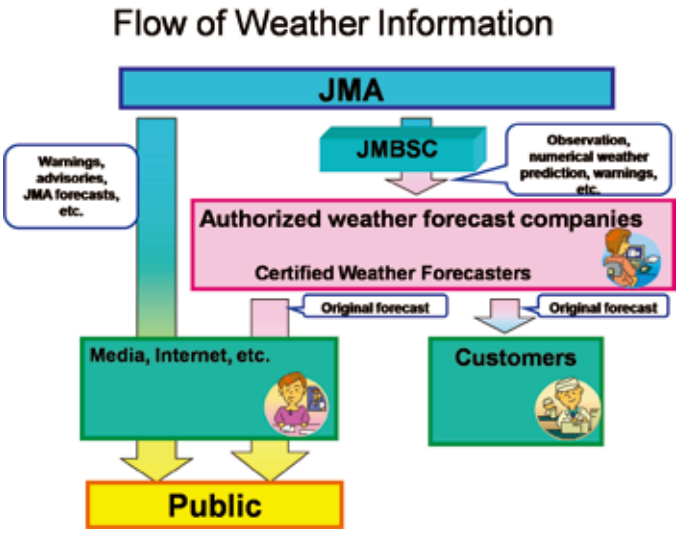
10 Promotion of Weather Information Usage

Support for Private-Sector Services and the Certified Weather Forecaster System

JMA offers a variety of meteorological data and products to the private weather service business sector at marginal cost to aid comprehensive operation in the field. Real-time and archived data are provided online and via CD-ROM, respectively, through the Japan Meteorological Business Support Center (JMBSC) – a public-service corporation designated by the Director-General of JMA. The Agency also strives to maintain dialogue with private weather companies in order to foster partnerships and increase mutual understanding.

In 1993, the Meteorological Service Act was revised to establish the Certified Weather Forecaster System, which provides meteorological experts with qualifications in forecasting by utilizing numerical weather prediction data. Japanese private weather companies require authorization from the Director-General of JMA to implement their own forecasting services and to retain Certified Weather Forecasters. The Certified Weather Forecaster examination is conducted by JMBSC under the designation of the Director-General of JMA.

The Agency also places high importance on the development of cooperative relations with the media. In addition to frequent press releases, including monthly interviews with the Director-General, JMA periodically holds dialogue with embedded press corps to exchange views toward the more effective dissemination of meteorological information.



JMA's Information Services for the General Public

To respond to inquiries from the general public regarding weather information, JMA operates Weather Information Offices at JMA Headquarters as well as at four DMOs (Sapporo, Sendai, Osaka and Fukuoka) and at the Okinawa Meteorological Observatory. These offices provide a wide range of information including data on current weather, forecasts and warnings as well as historical records, and contribute to enlightenment on various meteorological affairs.

Meteorological offices occasionally organize public seminars and lectures on the latest issues and topics relevant to meteorological services. JMA also operates the Meteorological Museum at its headquarters to raise public awareness of weather services and give an overview of its wide-ranging activities and facilities.

Calibration of Meteorological Instruments

Parties engaging in meteorological observation for publication, other than JMA, are requested to use officially calibrated instruments. JMA is responsible for the standardization and calibration of such equipment as the national authority in the field. Individual calibration is implemented through joint efforts by JMA and a registered private body.

Official Weather and Earthquake Records

JMA is authorized to issue official records and descriptions of weather and earthquake events upon request. This is mainly done for legal purposes.

11 International Cooperation

Since the atmosphere has no national borders, international cooperation and coordination is essential for the development of worldwide meteorological activities. JMA devotes consistent efforts to international cooperation through multilateral and bilateral channels alike, and has established procedures to engage in cooperative activities with many NHMSs and international organizations.

11-1 Cooperation through WMO and Other Multilateral Activities

The World Meteorological Organization (WMO) facilitates international cooperation in the meteorological field to coordinate, standardize and improve world meteorological activities. Japan is an active member of the organization, and successive Permanent Representatives of Japan with WMO (a role to which the Director-General is designated) have long served as members of the Executive Council by election of the Congress. JMA is a core member in the implementation of a number of scientific and technical WMO programs, with many experts contributing to Technical Commissions and associated working bodies of the organization. The Agency also operates a number of WMO regional and global centers for the WWW (World Weather Watch) Programme and others.

JMA is also actively involved in international programs organized by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Civil Aviation Organization (ICAO) and others.

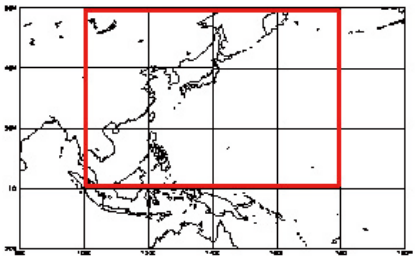
Weather monitoring and forecasting		
	Operation and data dissemination of geostational meteorological satellites (1978 ～)	Asia, Pacific
	WMO Global Data-processing and Forecast System (GDPFS) Regional Specialized Meteorological Center (RSMC) (1968 ～)	East Asia
	WMO GDPFS RSMC Tokyo-Typhoon Center (1988 ～)	East Asia
	ICAO Tropical Cyclone Advisory Center (TCAC) (1993 ～)	Asia, Pacific
	ICAO Volcanic Ash Advisory Center (VAAC) (1997 ～)	Asia, Pacific
	WMO GDPFS RSMC on the Provision of Transport Model Products for EnvironmentalEmergency Response (1997 ～)	Asia, Pacific
Telecommunication and observation systems		
	WMO Global Telecommunication System (GTS) Regional Telecommunication Hub (RTH) (1968 ～)	East Asia
	WMO Regional Radiation Center of RAII (RRC) (1965 ～)	Asia
	WMO Regional Instrument Center of RAII (1997 ～)	Asia
	GCOS Surface Network (GSN) monitoring Center (1999 ～)	World
Global Environment, Climate and Ocean		
	WMO Global Atmosphere Watch (GAW) World Data Centre for Greenhouse Gases (WDCGG) (1990 ～)	World
	WMO GAW Quality Assurance/Science Activity Center (QA/SAC) (1995 ～)	Asia, South-West Pacific
	WMO GAW World Calibration Center (WCC) (2002 ～)	Asia, South-West Pacific
	Tokyo Climate Center (2002 ～) as WMO Regional Climate Center (RCC) (2009 ～)	Asia, Pacific
	WMO/IOC Integrated Global Ocean Services System (IGOSS) Specialized Oceanographic Center (SOC) (1984 ～)	Pacific Ocean
	Marine observation data collection and archive under MCSS (Marine Climatological Summaries Scheme) (1964 ～)	Western North Pacific
Tsunami		
	Northwest Pacific Tsunami Advisory Center (2005 ～)	Northwest Pacific
	Issuance of Tsunami Watch Information (on an interim basis) (2005 ～)	Indian Ocean

International roles of JMA and their areas of responsibility

11-2 International Centers Operated by JMA

RSMC Tokyo - Typhoon Center

JMA is responsible for the analysis and forecasting of tropical cyclones (TCs) in the western North Pacific and the South China Sea (0° – 60°N, 100° – 180°E) in its role as the Regional Specialized Meteorological Center (RSMC) Tokyo - Typhoon Center, one of the six RSMCs responsible for TC forecasting within the framework of the World Weather Watch (WWW) Programme run by the World Meteorological Organization (WMO). On average, as many as 26.7 TCs are generated every year in the area, some of which have caused serious damage to affected countries in the past. Against this background, the RSMC Tokyo - Typhoon Center issues vital information on TCs such as analysis and forecasts eight times a day in order to assist in the disaster prevention activities of National Meteorological and Hydrological Services (NMHSs) in the area, especially those of ESCAP/WMO Typhoon Committee members. The Center's activities also include monitoring of data exchanges among members, issuance of publications such as annual reports and technical reviews, and provision of on-the-job training seminars held annually at JMA Headquarters.



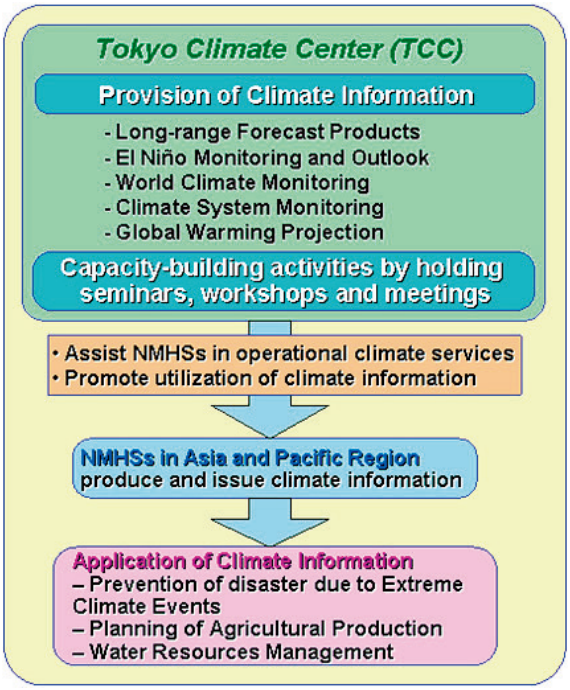
Area of responsibility of the Center

On-the-job training at JMA's operation room

Tokyo Climate Center (TCC)

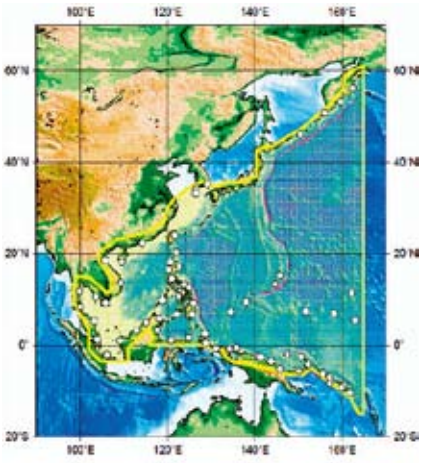
Recently, extreme climate events have caused a large number of serious disasters such as droughts and floods around the world, creating a significant social and economic impact. To mitigate the effects of such disasters, National Meteorological and Hydrological Services (NMHSs) play an important role in providing the general public and decision-makers with monitoring results and timely predictions of climate variability. JMA established the Tokyo Climate Center (TCC) to meet the requirements of NMHSs in this area and to contribute to the climate services they provide in the Asia-Pacific region.

TCC's mission is to assist with the climate information services of NMHSs in the Asia-Pacific region with the aim of mitigating climate-related disasters and contributing to sustainable development. The Center's two major activities involve providing basic climate data and products to NMHSs through its website and assisting with capacity building at NMHSs in the same region. To promote climate services for the benefit of individuals, organizations and countries around the world, WMO plans to establish an international collaborative framework composed of Global Producing Centers, Regional Climate Centers and NMHSs to facilitate climate services. TCC is committed to contributing to such WMO initiatives, and in June 2009 was designated as one of the first WMO RCCs along with China's Beijing Climate Center.



Activities of the Tokyo Climate Center

Northwest Pacific Tsunami Advisory Center



○ :Locations for which tsunami arrival times and heights are forecast.
▭ :NWPTA is issued when an earthquake with magnitude of 6.5 or larger occurs in this area

Tsunamis move across oceans without regard for national borders, often causing serious damage over extensive coastal areas. As a contribution to international endeavors for tsunami disaster prevention and mitigation under the framework of the Pacific Tsunami Warning System, JMA established the Northwest Pacific Tsunami Advisory Center (NWPTAC) in 2005 to provide countries in the Northwest Pacific region with detailed forecast information on tsunamis in the area.

NWPTAC monitors and analyses seismic data from overseas and domestic observation networks for rapid earthquake detection, and issues Northwest Pacific Tsunami Advisories (NWPTAs) when a large earthquake with tsunami-generating potential occurs in the region. An advisory contains estimated tsunami arrival times/heights and related observations. It is used in recipient countries to help trigger emergency response operations, and also serves as reference material for the issuance of national tsunami warnings.

JMA has also provided Tsunami Watch Information (TWI) to countries in the Indian Ocean on an interim basis since March 2005, triggered by the Indian Ocean Tsunami disaster of 2004.

11-3 Technical Cooperation

Technology transfer to developing countries in the field of meteorology is essential not only for the modernization of meteorological services in those countries but also for the promotion of international meteorological activities.

JMA has been providing expert services and training programs to developing countries for decades. In particular, the series of Japan International Cooperation Agency (JICA) training courses in meteorology has received more than 270 meteorologists from National Meteorological Services in developing countries since 1973.

Toward the implementation of Japanese government aid programs in the meteorological field, JMA provides a variety of technical support in cooperation with JICA and other national authorities.

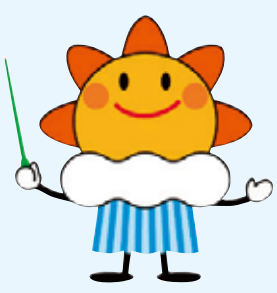
History

Meteorological services in Japan were initiated in 1875 by the Tokyo Meteorological Observatory (TMO) – part of the Ministry of the Interior. TMO was renamed the Central Meteorological Observatory (CMO) in 1887, and was transferred to become part of the Ministry of Education in 1895. In 1956, CMO became an affiliate agency of the Ministry of Transport (MOT) under the name of the Japan Meteorological Agency (JMA). In January 2001, MOT was reorganized into the Ministry of Land, Infrastructure and Transport (MLIT*). JMA now serves as one of the most advanced and leading National Meteorological Services in the world, assuming both national and international responsibilities.

Year	Event
1875	Tokyo Meteorological Observatory (TMO), predecessor of JMA, established within the Ministry of Interior.
1883	The first weather map issued.
1884	The first national weather forecast issued.
1884	Nation-wide seismic intensity observations started.
1887	TMO renamed the Central Meteorological Observatory (CMO).
1895	CMO transferred to the Ministry of Education.
1921	Oceanographic and marine meteorological observations begin.
1922	Meteorological Expert Education School, predecessor to the Meteorological College, established.
1930	Aviation weather service started.
1938	Radiosonde upper-air observations started.
1943	CMO transferred to the Ministry of Transport and Telecommunication.
1945	CMO placed under the Ministry of Transport (MOT).
1953	Japan joins World Meteorological Organization (WMO).
1954	Weather radar observations started.
1956	CMO becomes JMA, an affiliate agency of the Ministry of Transport.
1959	Numerical weather predictions started.
1969	Automated Data Editing and Switching System (ADESS) established.
1974	Automated Meteorological Data Acquisition System (AMeDAS) established.
1977	GMS-1, JMA's first geostationary meteorological satellite launched.
1991	Seismic intensity meters observations started.
1993	Meteorological Service Law revised to establish Certified Weather Forecasters System.
2001	JMA placed under the Ministry of Land, Infrastructure and Transport (MLIT*).

Chronology of the Japan Meteorological Agency

*MLIT was reorganized into the Ministry of Land, Infrastructure, Transport and Tourism in January 2008.



Mascot of JMA

The JMA mascot, nicknamed *Harerun* in Japanese with expectations of hare (fine weather), is designed with a motif of the sun, a cloud and rainfall. It holds a green baton as a symbol of hope for a disaster-free and peaceful world. The mascot helps to raise public awareness of meteorological services (including natural disasters and global environmental problems) during various events at the Meteorological Museum and local offices.

Photographs on the cover pages were taken by the following members from JMA's photographer group "Sharaku-kai";
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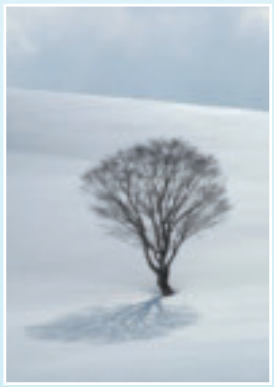

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