COUNTRY REPORT

ESCAP/WMO Typhoon Committee

42nd Session

25 - 29 January 2010

Singapore

JAPAN

CONTENTS

I. Overview of tropical cyclones which have affected/impacted Member's area since the last Typhoon Committee Session

1. Meteorological Assessment (highlighting forecasting issues/impacts)

In 2009, eight tropical cyclones (TCs) of tropical storm (TS) intensity or higher had come within 300 km of the Japanese islands as of the end of October. Five of them affected Japan, and one made landfall. The details of the five TCs that affected the country are described below, and their tracks are shown in Figure 1.

(1) TY Morakot (0908)

Morakot was upgraded to tropical storm (TS) intensity southeast of Minamidaitojima Island at 18 UTC on 3 August. After changing direction from eastward to westward on 4 August, it was upgraded to typhoon (TY) intensity southeast of Okinawa Island at 18 UTC the next day before reaching its peak intensity with maximum sustained winds of 75 kt and a central pressure of 945 hPa south of Ishigakijima Island at 15 UTC on 6 August. Maintaining its westward track and TY intensity, Morakot hit Taiwan Island late the next day. Turning gradually to the north, it hit Fujian Province on 9 August. After moving northward with diminishing intensity, it weakened to TD level southwest of Shanghai at 18 UTC on 10 August.

A peak gust of 45.1 m/s and daily rainfall of 257.0 mm were observed at Yonagunijima Island (47912). Damage to farm products, power outages and flight cancellations were reported in Okinawa.

(2) TS Etau (0909)

Etau was upgraded to tropical storm (TS) intensity south of Japan at 06 UTC on 9 August. It reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 992 hPa at 00 UTC the next day. After recurvature south of Honshu Island, Etau moved eastward and weakened to TD intensity over the sea east of Japan at 00 UTC on 13 August.

Total precipitation of 784 mm at a station in western Japan was recorded from 8 to 11 August, and a total of 27 people were killed or unaccounted for. Floods, landslides and damage to houses were reported all over Japan except in Okinawa and Hokkaido (Figure 2).

(3) STS Krovanh (0911)

Krovanh was upgraded to tropical storm (TS) intensity southeast of the Ogasawara Islands at 12 UTC on 28 August. Turning to the northwest, it was upgraded to severe tropical storm (STS) intensity at 18 UTC the next day before reaching its peak intensity with maximum sustained winds of 60 kt and a central pressure of 975 hPa 24 hours later. It turned to the north again and passed east of Hachijojima Island early on 31 August. Krovanh accelerated northeastward along the eastern coast of Honshu and transformed into an extratropical cyclone east of Hokkaido at 12 UTC on 1 September.

A peak gust of 42.7 m/s was observed at Hachijojima Island (47678). Cancellations of trains and flights were reported in the Kanto region.

(4) TY Melor (0918)

Melor was upgraded to tropical storm (TS) intensity north of Pohnpei Island at 12 UTC on 29 September 2009. Moving west-northwestward, it was upgraded to typhoon (TY) intensity east of the Mariana Islands at 00 UTC on 1 October before reaching its peak intensity with maximum sustained winds of 110 kt and a central pressure of 910 hPa south of Okinotorishima Island. After recurving northward west of Minamidaitojima Island late on 6 October, it moved northeastward south of Japan. Keeping its northeast track, Melor made landfall in Honshu late the next day with TY intensity, and transformed into an extratropical cyclone east of Hokkaido at 06 UTC on 9 October.

A peak gust of 58.9 m/s was observed at Minamidaitojima Island (47945). Five people were killed, and damage to houses, power outages and cancellations of trains and ships were reported all over Japan.

(5) TY Lupit (0920)

Lupit was upgraded to tropical storm (TS) intensity north of Yap Island at 18 UTC on 15 October 2009. Moving west-northwestward, it was rapidly upgraded to typhoon (TY) intensity far east of the Philippines 18 hours later. Moving northward and slowing down, it reached its peak intensity with maximum sustained winds of 95 kt and a central pressure of 930 hPa south of Okinotorishima Island at 18 UTC on 18 October. Moving northward then westward, it gradually weakened in intensity south of the Okinawa Islands from 19 to 22 October. Lupit rapidly turned to the northeast of Luzon Island on 23 October. It approached the area around Minamidaitojima Island late on 25 October and then the area around Hachijojima Island late the next day. It transformed into an extratropical cyclone east of Hokkaido at 06 UTC on 27 October.

One-hour precipitation of 132.5 mm was observed at a station in Okinawa, and power outages and landslides were reported in the region.

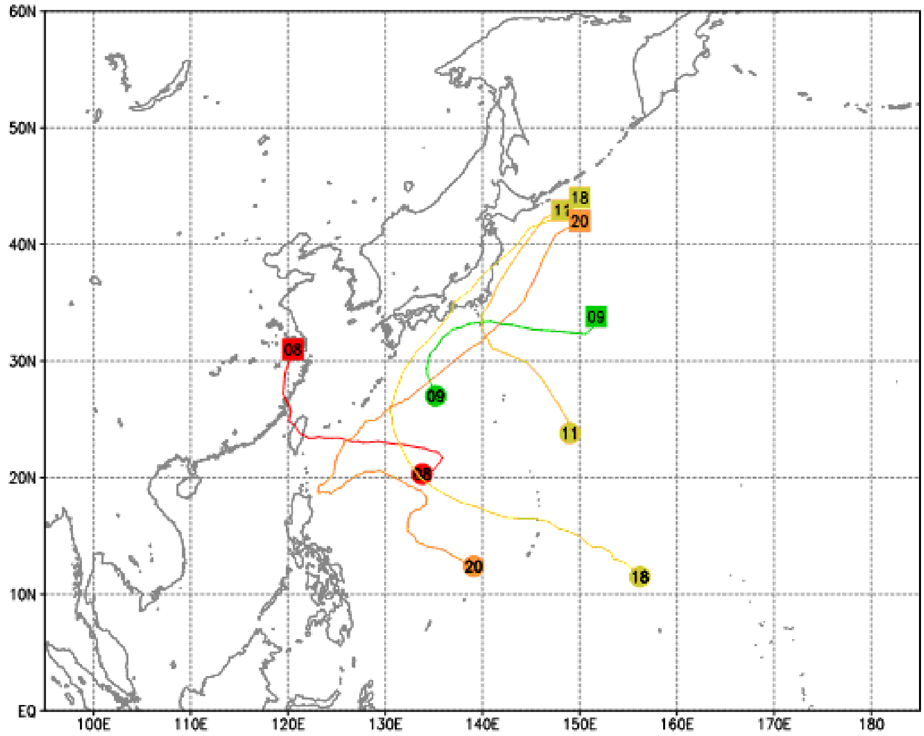


Figure 1　Tracks of the five named TCs that affected Japan in 2008
The numbered circles represent the genesis point of each named TC, while the squares show the dissipation point. The numbers indicate the last two digits of the identification number for each named TC.

Figure 2　Flooding in Hyogo prefecture (Photos by JMA)
Broken riverbanks (left) and a destroyed house (right) caused by flooding in western Japan’s Hyogo Prefecture

2. Hydrological Assessment (highlighting water-related issues/impact)

Damage by Typhoon Etau (TY 0909)

A tropical low pressure system located south of Japan on August 8 developed into Typhoon Etau (Typhoon No. 9) at 21:00 on August 9, and continued moving northward over the ocean off the Kii Peninsula. The extremely humid atmospheric conditions brought by this system and the typhoon caused heavy rainfall over a widespread area from the Chugoku and Shikoku regions up to the Tohoku region.

Total precipitation from the beginning of this rainfall event exceeded 700 mm at some places in Shikoku. Totals between 15:00 on August 8, and 15:00 on August 11 were also reported from several places, including values of 783.5 mm at Kitohizuhara in Tokushima Prefecture's Naka Town, 466.5 mm at Funato in Kochi Prefecture's Tsuno Town, 349.5 mm at Sayo in Hyogo Prefecture, and 252.5 mm at Imaoka in Okayama Prefecture's Mimasaka City.

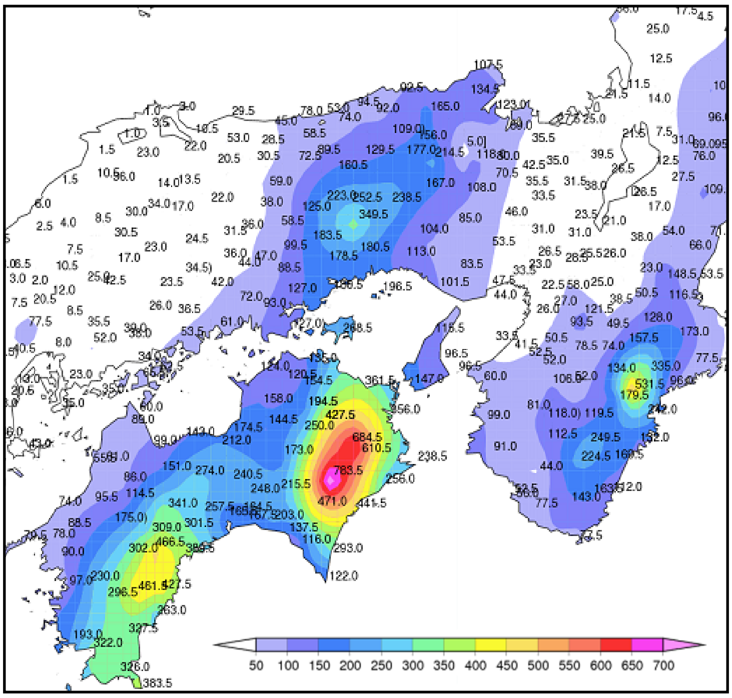


Figure 3 AMeDAS total rainfall (15:00, Aug. 8 – 12:00, Aug. 11)

This heavy rainfall event caused flooding and landslides throughout Japan from Shikoku to Kanto and further north up to Tohoku. A total of 962 houses were flooded above first-floor level and 4,399 below first-floor level (as of 15:00, October 26). In particular, overtopping and flooding occurred along the Sayogawa River in Hyogo Prefecture, resulting in 938 houses being partially destroyed, 334 houses flooded above first-floor level and 1,491 below first-floor level (as of 15:00, October 26).

Fatalities	Missing	Injured	Houses totally destroyed	Houses partially destroyed	Houses partially damaged	Houses flooded above floor level	Houses flooded below floor level
25	2	23	181	1,125	30	962	4,399

Table 1　Damage (Source: Fire and Disaster Management Agency, as of 15:00, Oct.26, 2009 – 12:00, Aug. 11)

Figure 2　Damage in Hyogo Prefecture
Sayogawa River (Sayo Town, Hyogo Prefecture) and damaged road bridge (Asago City, Hyogo Prefecture)

3. Socio-Economic Assessment (highlighting socio-economic and DPP issues/impacts)

4. Regional Cooperation Assessment (highlighting regional cooperation successes and challenges)

II. Summary of progress in Key Result Areas

1. Progress on Key Result Area 1: Reduced Loss of Life from Typhoon-related Disasters.

a. Meteorological Achievements/Results

b. Hydrological Achievements/Results

c. Disaster Prevention and Preparedness Achievements/Results

c-1. Major Disaster and Response Measures since January 2009

In 2009, Japan suffered from a number of bouts of torrential rain. In particular, heavy rain from 19 to 21 July 2009 caused 31 deaths, and resulted in 2,191 houses with inundation above floor level. Typhoon No.9 (ETAU) also caused 25 deaths, and resulted in 962 houses with inundation above floor level. The national government's response included early warning reports from the Japan Meteorology Agency (JMA), inter-ministerial meetings for response coordination, and same-day dispatching of governmental on-site damage survey teams, headed by the Minister of State for Disaster Management.

c-2. Technical Investigation on Large-Scale Flood Countermeasures

There has been a large reduction in the total area inundated by flood disasters thanks to weather forecasting system improvement and the promotion of land conservation and flood control projects over many years. However, in terms of general assets, the amount of damage in flooded areas has greatly increased in recent years (Figure 3). Additionally, the frequency of downpours depositing more than 100 mm of rain per hour has seen an increasing trend throughout the country over the last 30 years (Figures 4, 5).

This increasing trend necessitates the strengthening of countermeasures for quick and smooth evacuation and relief activities in the event of large-scale flooding. The Central Disaster Management Council is working on analysis of anticipated situations and reviewing measures against large-scale flood disasters that are expected to cause immense damage to the capital region.

The Central Disaster Management Council, chaired by the Prime Minister and manned by other Ministers of State, focuses on the promotion of comprehensive disaster countermeasures. The Cabinet Office of the Japanese Government initiated an expert study for analysis of possible large-scale flood damage in Japan. The trigger for this investigation was Hurricane Katrina, which caused devastating damage in the U.S. in August 2005. Another reason was the fact that there have been no incidents of such devastating typhoons or floods in Japan for as long as 50 years (since Typhoon Ise-wan in 1959), meaning that the majority of the population is unaware of the possibility of such a catastrophe.

The study was started in 2006 and is still under way, but some interesting analysis has already been conducted. One such example is the simulation of a potential flood area in the Tone River basin (the largest river basin in Tokyo). A map of the flood area was simulated, assuming river dike bleach caused by hypothetical deadly rainfall with a once-in-200-year likelihood. In the worst-case scenario, more than two million people could be affected by the flood, and nearly a million houses could be damaged. Although this is only a simulation, it is important that the potential magnitude of related damage is properly understood by the government and residents alike. (Figure 6)

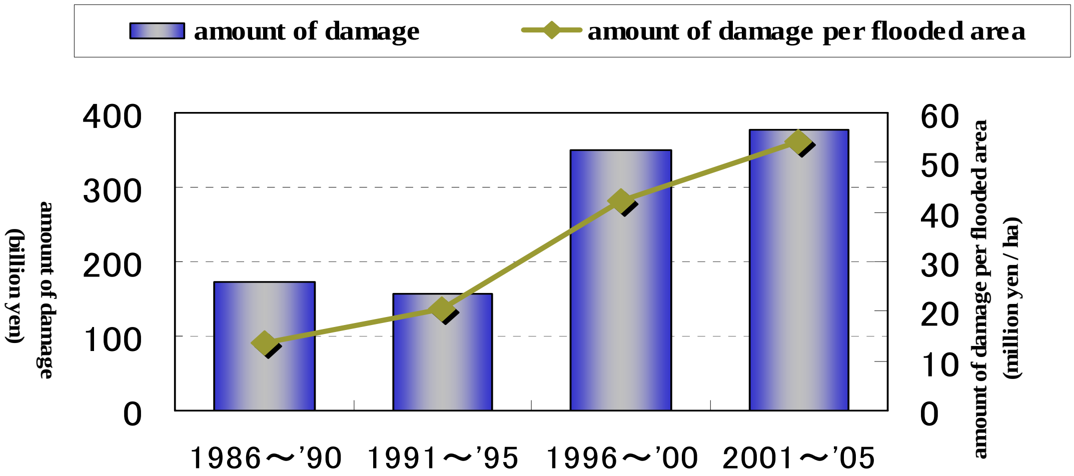


Figure 3　Amount of damage to general assets in flooded areas

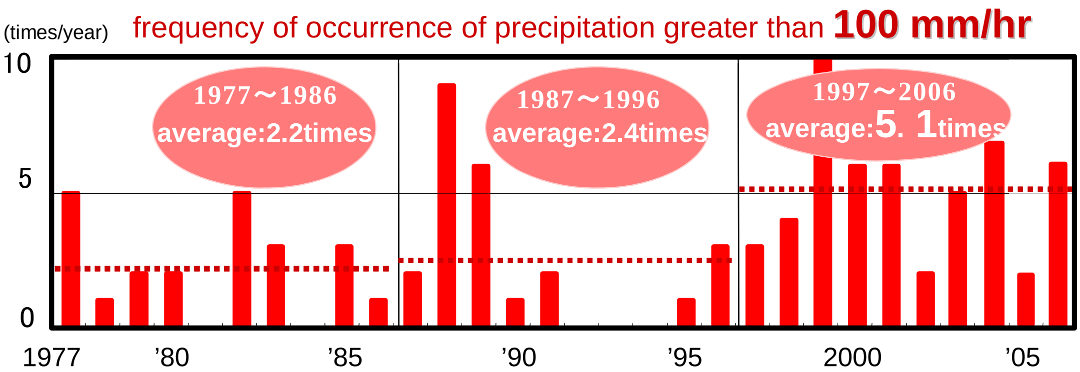


Figure 4　Tendency of downpours (over 100 mm/hr)

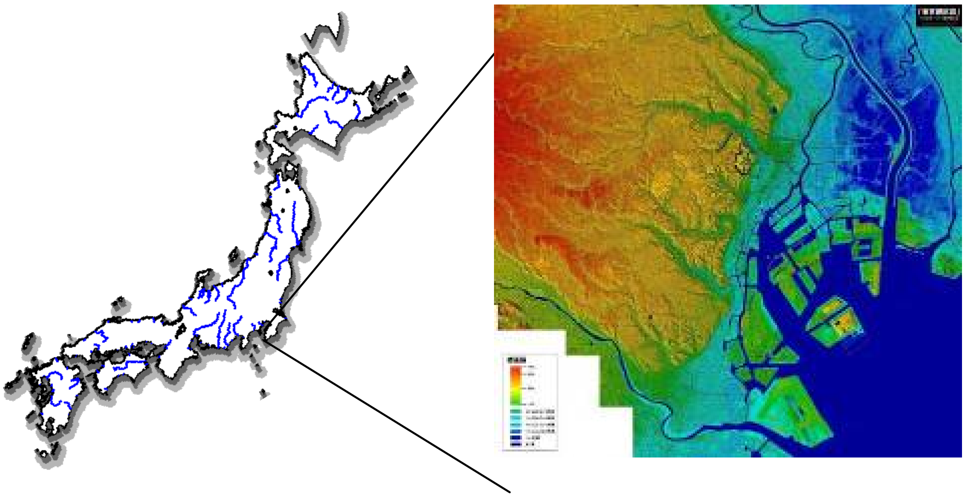
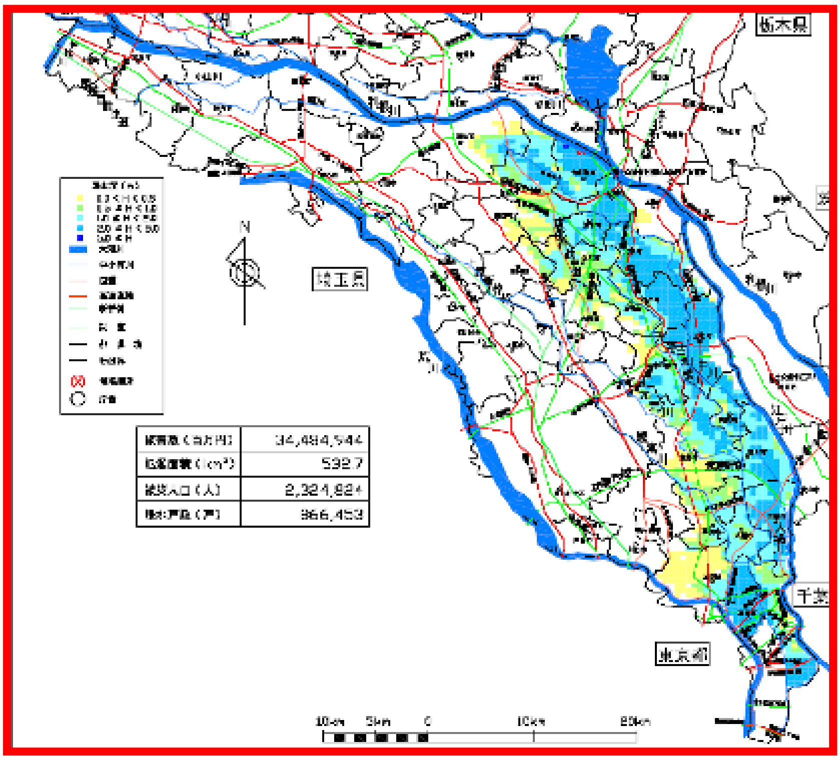


Figure 5　Metropolitan areas of zero meters in altitude



Flooded area (hectares)	53,000
Affected population	2,300,000
Flooding above floor level	690,000 houses
Flooding below floor level	170,000 houses

Figure 6　Flood area simulation for the Tone River in Tokyo

d. Research, Training, and Other Achievements/Results

d-1. Technical Emergency Control Force for Disaster Assistance

Established in 2008, the Technical Emergency Control Force (TEC-FORCE) consists of teams of experts for different purposes formed by different agencies within the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), such as the River Bureau, the National Institute for Land and Infrastructure Management, the Japan Meteorological Agency, the Geographical Survey Institute and regional branch bureaus. When a large-scale disaster occurs or is likely to occur due to a typhoon or earthquake, TEC-FORCE teams are dispatched to provide technical assistance by swiftly assessing disaster situations and working to prevent and contain damage. They assist in early recovery and smooth, swift implementation of emergency measures required by municipalities in affected areas.

Immediately after the occurrence of a large-scale disaster, damage to infrastructure supporting local lifelines such as roads often interrupts life-saving activities and the stable daily lives of residents. However, municipalities originally responsible for such infrastructure are very likely to be overwhelmed in responding to residents' emergency needs, meaning that they cannot fully perform the tasks needed to confirm infrastructure damage and start recovery efforts. Composed of national government employees with expertise in infrastructure management and experience in disaster response, TEC-FORCE is designed to provide professional support to assist municipalities across Japan in the event of such circumstances.

In 2009, TEC-FORCE teams were dispatched to the Chugoku region and northern Kyushu due to heavy rainfall from July 19 to 26. Other teams were also sent to areas affected by Typhoon No.9 from August 8 to 11 and the earthquake of August 11 centered in Surugawan Bay. In these three disasters, a total of 1,287 personnel, including TEC-FORCE members and other experts, participated in damage assessment by helicopter and on the ground. A TEC-FORCE team also provided assistance in quick recovery by giving advice on recovery work. Their efforts were greatly appreciated by the municipalities involved, and in some cases the dispatched teams received letters of appreciation.

Figure 7 Damage assessment on the ground

Figure 8 Damage assessment by helicopter

Figure 9 Technical assistance team (advising on recovery works)

(KRA2, 4)

e. Regional Cooperation Achievements/Results

e-1. Projects for the *Debris Flow and Landslide Warning System* and *Hazard Mapping for Sediment-related Disasters*

Japan has taken the initiative in the Project for the Debris Flow and Landslide Warning System since 2002 up until this year through activities of the Typhoon Committee (TC). To start with, we proposed the Japanese method for setting the base rainfall used to trigger warnings and evacuations as a criterion to release sediment-related disaster warning information. Since then, individual TC member countries have selected model sites and worked to put the method into domestic operation by modifying it based on their own needs and conditions. The final project report published this fiscal year reported progress in several member countries including China, Malaysia, Vietnam, the Philippines, Thailand, the United States and Japan.

In light of increased technical understanding regarding the issuance of warning information among these countries, the next project, Hazard Mapping for Sediment-related Disasters, was launched in 2009 for the purpose of identifying areas at high risk of sediment-related disasters. Each participating country is currently selecting a model site for hazard mapping.

In Japan, a heavy rainfall event caused large-scale, simultaneous sediment-related disasters in July 2009 in Yamaguchi Prefecture's Hofu City, resulting in 14 deaths including 7 elderly people who were killed when debris flow directly hit their nursing home. Under Japan's Sediment-Related Disaster Prevention Law, local municipalities are responsible for the development of warning and evacuation systems in areas deemed to have a certain level of disaster risk. The nursing home was located in such an area. In this fatal incident, human lives were lost because of problems with information communication despite sediment-related disaster warning information having been issued before the actual debris flow occurred. The incident demonstrated that forecasting and warnings alone will not always be adequate as countermeasures for sediment-related disasters, and reminded us that hazard mapping for such disasters can be an effective countermeasure to prevent damage by designating high-risk areas and promoting precautions.

Figure 10 Nursing home hit by debris flow (Hofu City, Yamaguchi Prefecture)

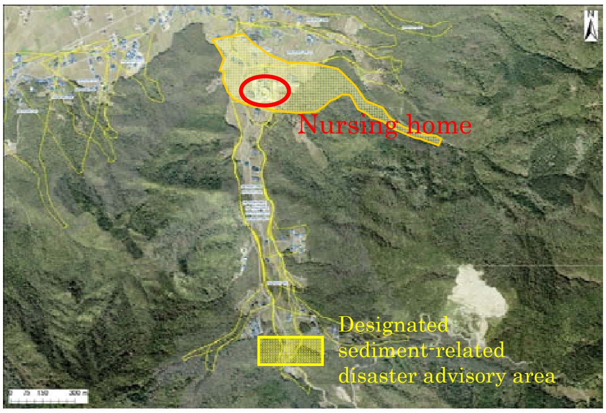


Figure 11 The designated sediment-related disaster advisory area surrounding the nursing home

(KRA2, 5, 6, 7)

f. Identified Opportunities/Challenges for Future Achievements/Results

2. Progress on Key Result Area 2: Minimized Typhoon-related Social and Economic Impacts.

a. Meteorological Achievements/Results

a-1. JMA's Five-day Track Forecasts

As of 22 April 2009, the RSMC Tokyo - Typhoon Center of the Japan Meteorological Agency (JMA) started issuing five-day track forecasts every six hours in addition to the existing three-day track and intensity forecasts. The new reports include center positions and radii of probability circles* for the fourth and fifth forecast days, which contribute to improving early warning activities against tropical cyclones (TCs). These five-day track forecasts have been realized mainly as a result of recent improvements in numerical weather prediction, including the development of the Typhoon Ensemble Prediction System (TEPS).

* Probability circle: a circular range in which a TC is expected to be located with a probability of 70% at each forecast time, indicating the uncertainty of the forecast

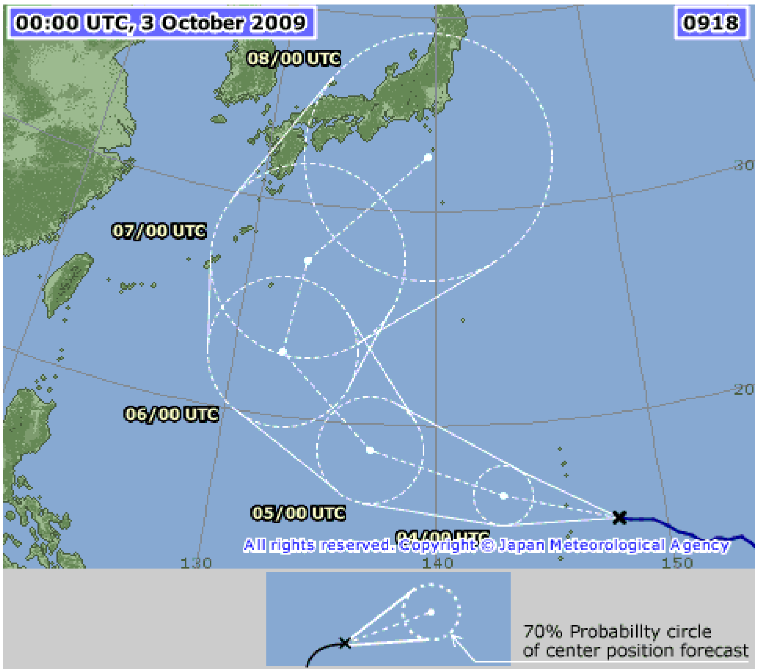


Figure 12 Examples of a five-day track forecast, tropical cyclone Melor (0918)

(KRA1, 4, 5, 6)

b. Hydrological Achievements/Results

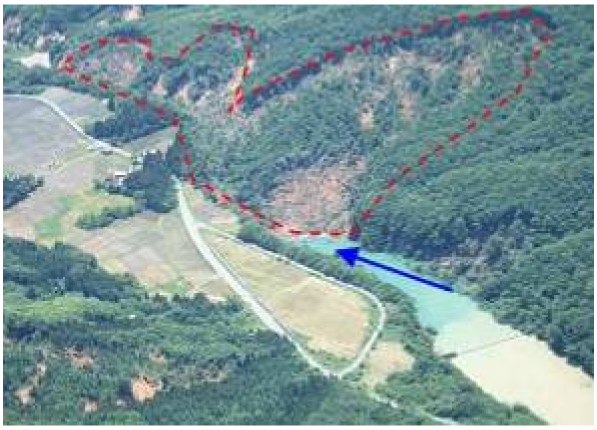
b-1. Enhancement of Countermeasures for Large-scale Sediment-related Disasters Involving Landslide Dams

Based on the understanding that it is the national government's essential responsibility to protect the lives and property of the country's citizens from earthquakes, floods and other disasters, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) organizes and dispatches Technical Emergency Control Force (TEC-FORCE) teams to affected areas to quickly assess damage status as part of efforts to better respond to natural disasters, which have been increasingly frequent in recent years. As local governments have little experience in coping with major natural disasters, they lack the technical expertise needed to respond to them.

In March 2009, MLIT amended a Ministerial Ordinance to allow the national government to initiate countermeasures for sediment-related emergencies in the event of a large-scale natural disaster, regardless of the responsibilities and jurisdiction of the local governments that usually lead such efforts. The revised ordinance was soon applied to the July 2009 disaster in Yamaguchi Prefecture's Hofu City for the first time, and countermeasures for sediment-related disasters were directly conducted by a local MLIT branch office. In the face of a large-scale natural disaster, it is essential for the national government to step in and take direct countermeasures based on experience and knowledge gained by coping with a variety of natural disasters in the past.

Heavy rainfall events and earthquakes have resulted in the formation of as many as 82 landslide dams throughout Japan in the past 200 years. A landslide dam is created when a landslide blocks a river channel, and can result in large-scale disaster once the river breaches it and causes debris flow. In 2008 when an inland earthquake affected parts of Iwate and Miyagi Prefectures, 15 landslide dams formed in a limited area within a 20-km radius. The affected area is basically under the jurisdiction of the local government, but since it required a high level of technical expertise to implement measures against landslide dams breach, we directly implemented countermeasure work such as pump drainage and construction of an interim diversion to lower water levels, thereby coping with 9 urgent major landslide dams among the 15 in response to requests from local governors.

Based on the case of Iwate and Miyagi, MLIT set up a research committee on risk management for large-scale landslide dams. The committee has made recommendations for such management and contributed to further progress in the field.



A landslide dam is formed by a landslide

Pumps are used to drain water while a drainage channel is constructed

The trapped water drains through the drainage channel

Figure 13　Removal process of a landslide dam

（KRA1, 4, 5）

c. Disaster Prevention and Preparedness Achievements/Results

d. Research, Training, and Other Achievements/Results

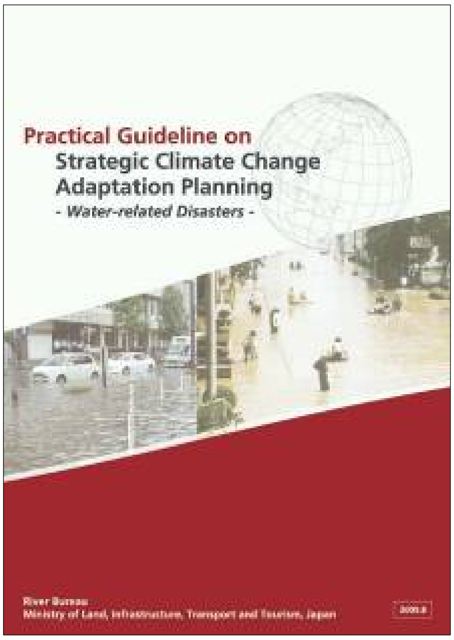
e. Regional Cooperation Achievements/Results

e-1. Publication of “Practical Guideline on Strategic Climate Change Adaptation Planning – Water-related Disasters –”

Severer floods due to climate change occur on a global scale and are common issues facing the international community, although the degree of impact varies by region. Located in the Asian Monsoon region, some Asia-Pacific countries have climatic and geological conditions similar to those of Japan, and their areas of production and inhabitation are based mostly on alluvial plains.

The guideline prepared by experts in the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) describes a framework for procedures to develop adaptation measures against severer flood disasters due to climate change based on experiences, strategies and technologies accumulated in Japan. The publication mainly targets countries facing conditions such as: 1) expected socio-economic development and urbanization due to population growth; 2) a basis of living and production situated on alluvial plains; and 3) underdeveloped flood control measures (e.g., countries in the Asia-Pacific region and others).

Compared with existing guidelines on flood management, the importance of estimating future meteorological external forces such as precipitation is higher in the development of climate change adaptation measures. Accordingly, the publication contains a full account outlining the setting of meteorological external forces.



In order to make an international contribution by implementing technical support to concrete climate change adaptation planning in the Asia-Pacific region, MLIT established “Advisory board on promotion of international contribution regarding climate change adaptation measures”, which consists of academic experts (chaired by Prof. Toshio KOIKE of Tokyo University) in June 2009.Based on suggestions from the advisory board, the guideline will be further improved. MLIT hopes to contribute to the promotion of effective adaptation measures in the Asia-Pacific region by utilizing the guideline through various activities such as Climate Change and Adaptation Knowledge Hubs in Asia Pacific Water Forum (APWF), bilateral cooperation by JICA, and so on.

(http://www.mlit.go.jp/river/basic_info/english/climate.html)

(KRA1,5 ,7)

f. Identified Opportunities/Challenges for Future Achievements/Results

3. Progress on Key Result Area 3: Enhanced Beneficial Typhoon-related Effects for the Betterment of Quality of life.

a. Meteorological Achievements/Results

b. Hydrological Achievements/Results

c. Disaster Prevention and Preparedness Achievements/Results

d. Research, Training, and Other Achievements/Results

e. Regional Cooperation Achievements/Results

f. Identified Opportunities/Challenges for Future Achievements/Results

4. Progress on Key Result Area 4: Improved Typhoon-related Disaster Risk Management in Various Sectors.

a. Meteorological Achievements/Results

a-1. JMA's Climate Change Monitoring Report

JMA describes inter-annual variability and long-term trends regarding typhoon activity in its "Climate Change Monitoring Report" every year. This is distributed to the Japanese public as well as to NHMSs via the Tokyo Climate Center's website (http://ds.data.jma.go.jp/gmd/tcc/tcc/products/gwp/gwp.html).

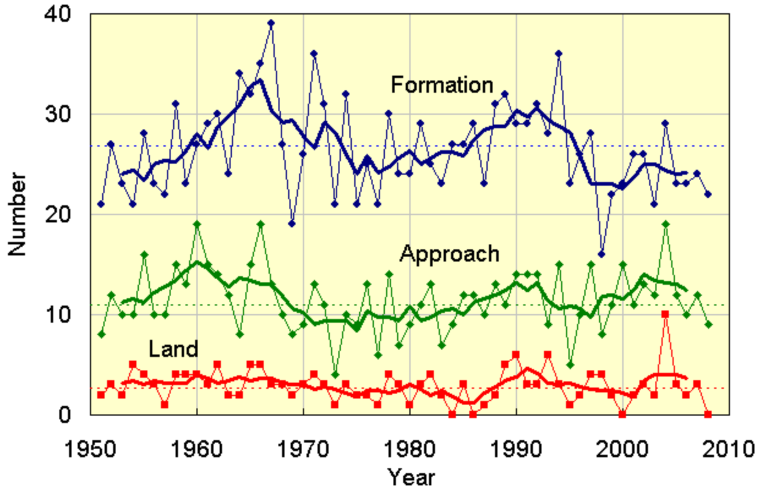


Figure 16 The number of tropical cyclones (TS or higher) forming in the western North Pacific (top), those that approached Japan (middle) and those that hit Japan (bottom). The thin, solid and dashed lines represent annual/five-year running means and normal values (1971–2000 averages), respectively.

(KRA1, 2, 5, 6,)

b. Hydrological Achievements/Results

c. Disaster Prevention and Preparedness Achievements/Results

c-1. Visiting Researchers from ADRC Member Countries

The ADRC receives visiting researchers from member countries; 44 officials from participating nations have so far taken part in this program.

A list of visiting researchers is provided below.

	Name	Country	Term at the ADRC		
1	Shim Kee-Oh	Republic of Korea	1999/07/23	—	1999/10/11
2	Ngo Van Sinh	Vietnam	1999/12/10	—	2000/03/17
3	Lek Nath Pokharel	Nepal	2000/01/12	—	2000/05/07
4	Nimal D. Hettiarachchi	Sri Lanka	2000/04/13	—	2000/10/12
5	M. Babul Aknter	Bangladesh	2000/05/12	—	2000/11/16
6	W. A. Chulananda Perera	Sri Lanka	2000/11/13	—	2001/04/05
7	Hiripsime Vardanyan	Armenia	2001/03/09	—	2001/06/04
8	Philomena Miria	Papua New Guinea	2001/06/04	—	2001/12/03
9	So Ban Heang	Cambodia	2001/06/04	—	2001/12/04
10	Md. Atikuzzaman	Bangladesh	2002/01/09	—	2002/06/30
11	Tigran Sayiyan	Armenia	2002/02/23	—	2002/08/22
12	Khun Sokha	Cambodia	2002/07/29	—	2002/12/25
13	V. P. Pasrija	India	2002/10/05	—	2002/12/25
14	Dilli Pd. Shiwakoti	Nepal	2003/01/08	—	2003/07/02
15	Bolormaa Borkhuu	Mongolia	2003/01/08	—	2003/07/05
16	Vilayphong Sisomvang	Lao PDR	2003/07/08	—	2003/12/25
17	Rachman Sobarna	Indonesia	2003/07/09	—	2003/09/30
18	Om Prakash	India	2003/10/08	—	2003/12/24
19	Rahmonov Suhrobsho	Tajikistan	2004/01/14	—	2004/06/10
20	Nguyen Thanh Phuong	Vietnam	2004/01/27	—	2004/06/29
21	Yuan Yi	China	2004/07/19	—	2004/10/15
22	Bouasy Thammasack	Lao PDR	2004/07/21	—	2004/12/24
23	Shyam Sunder	India	2005/10/02	—	2005/12/25
24	Ross Sovann	Cambodia	2005/01/23	—	2006/06/30
25	Bal Bahadur Malla	Nepal	2005/01/30	—	2006/06/29
26	Maria Matilde Limpahan Go	Philippines	2005/07/13	—	2005/12/27
27	Diloro Mirzovatanovna Mirova	Tajikistan	2005/07/15	—	2005/12/21
28	Lyudmila Harutyunyan	Armenia	2006/01/11	—	2006/04/10
29	G.M.J.K. Gunawardana	Sri Lanka	2006/03/01	—	2006/06/30
30	San-Hyeok Kang	Republic of Korea	2006/07/01	—	2006/12/15
31	Altanchimeg Shaazan	Mongolia	2007/01/09	—	2007/06/30
32	Arun Pinta	Thailand	2007/01/14	—	2007/06/30
33	Nwet Yin Aye	Myanmar	2007/07/06	—	2007/12/31

34	Karybai uulu Kanat	Kyrgyz Republic	2007/07/04	—	2007/12/31
35	Zhang Yunxia	China	2008/01/01	—	2008/05/28
36	Zafar Waqar Taj	Pakistan	2008/02/23	—	2008/06/24
37	Vu Thanh Liem	Viet Nam	2008/07/11	—	2008/12/17
38	Shambhu Prasad Marasini	Nepal	2008/07/11	—	2008/12/19
39	Muhammad Khalil Bin Aziz	Malaysia	2009/1/15	—	2009/06/24
40	Areerat Wijitpatchraphon	Thailand	2009/1/15	—	2009/06/24
41	Predeep Kodippili	Sri Lanka	2009/8/6	—	2009/10/17
42	Porcil Josefina Tan	Philippines	2009/8/5	—	
43	Mishra Sagar	Nepal	2009/8/6	—	
44	Shahid Hussain Malik	Pakistan	2009/8/7	—	

d. Research, Training, and Other Achievements/Results

d-1. Disaster Management Policy Program: Water-related Risk Management Course

To cope with the growing threat of water-related disasters, there is an urgent need to build an active network of experts and professionals to deal with the issues involved, particularly in developing countries that have proven to be more vulnerable to natural disasters. Such experts are expected to acquire a broad understanding of all aspects of disaster management.

In response to this need, ICHARM offers a master's degree program called the Water-related Risk Management Course in Disaster Management Policy Program, which started in October 2007. This is a one-year program jointly organized by ICHARM and the National Graduate Institute for Policy Studies (GRIPS) with the support of the Japan International Cooperation Agency (JICA).

As of the beginning of 2010, 13 master’s course students were enrolled in the course, 4 of whom were from the TC region (Japan, China, Thailand and Philippines).

Figure 17　Management course students for the year 2009-2010

(KRA1, 2, 5, 7)

d-2. Implementation of JICA's *Comprehensive Management of Rivers and Dams* Group Training Program

The River Bureau of the Ministry of Land, Infrastructure, Transport and Tourism(MLIT), the National Institute for Land and Infrastructure Management, PWRI and JICA have served as implementing agencies for the JICA Comprehensive Management of Rivers and Dams group training program that began in 1973.

These organizations have provided engineers working on flood control administration and water resources development plans worldwide to give lectures on the Japanese Government's flood management measures. They have also conducted exercises related to hydrological statistics and runoff analysis, lectures and exercises on dam design and construction, and on-the-spot visits to relevant facilities. As of 2009, engineers had been invited from China, Indonesia, Iraq, the Philippines, Myanmar, Syria and Pakistan during the period from September to December for the training.

Figure 18　Trainees of the program

(KRA1, 2, 5, 7)

e. Regional Cooperation Achievements/Results

e-1. Project for the Development of Flood Disaster Preparedness Indices

Strengthening disaster preparedness and identifying, assessing and monitoring disaster risk are issues highlighted in the Five Priorities for Action under the Hyogo Framework for Action adopted in Jan. 2005. In many countries, however, assistance from the central government is often insufficient and slow when disasters occur. In such cases, raising the disaster preparedness level of communities/local governments is an essential part of disaster management. However, there are no widely recognized indicators that can be used for periodical self-assessment in localities. To fill this gap, this project was proposed and adopted for implementation with the objective of improving disaster preparedness in local governments and communities.

In order to create a well-organized set of indicators, it was agreed that these would be developed according to the disaster management cycle enriched based on feedback from TC members. To this end, ICHARM developed a crude set of indicators for model trial/evaluation and launched a new website exclusively for this purpose (www.fdpi.info) in Jan. 2010. TC members are currently encouraged to select several model communities and model-test the proposed set of indicators using a questionnaire-based approach. Reporting on intermediate results is expected at the 42nd TC annual session.

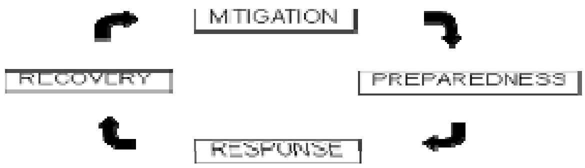


Figure 19 Disaster management cycle

(KRA1, 2, 5, 6, 7)

f. Identified Opportunities/Challenges for Future Achievements/Results

5. Progress on Key Result Area 5: Strengthened Resilience of Communities to Typhoon-related Disasters.

a. Meteorological Achievements/Results

a-1. JMA Mobile Observation Team

In October 2008, JMA named its disaster survey team the Mobile Observation Team (JMA-MOT). Survey teams from JMA carry out field surveys to ascertain actual conditions and provide scientific explanations of events after natural disasters such as severe storms, earthquakes, tsunamis, volcanic eruptions and storm surges. JMA gave a unified name to the survey team to familiarize the public with its activities and contribute to the reinforcement of community resilience and risk management authorities after disasters. Once a disaster occurs, the relevant local meteorological observatory organizes and dispatches the Mobile Observation Team based on agreement with the local government. Another mission of this Team involves public relations; the local meteorological observatory issues an official announcement on the dispatch of JMA-MOT just after the decision to send them out, and releases the field survey report as soon as possible, which is expected to reduce anxiety among the public.

(KRA4, 6)

b. Hydrological Achievements/Results

c. Disaster Prevention and Preparedness Achievements/Results

d. Research, Training, and Other Achievements/Results

d-1. Training Course on Local Disaster Management Planning with Flood Hazard Maps

ICHARM ran the Flood Hazard Map Training Course from 2004 to 2008, representing a significant contribution to promoting the TC project of the same name. To build on past achievements and further promote the establishment of solid local disaster management plans in developing countries, this new training course was launched and conducted for a period of three weeks in Nov. 2009 in collaboration with JICA. The Overall Goal is to reduce flood damage in participants' countries by making local disaster management plans that combine flood hazard maps and flood forecasting/warning systems and by strengthening local resilience against floods. The program's objective is to help trainees develop the direction and scheduling of local disaster management plans combined with flood hazard maps and flood forecasting/warning systems. The first year of training on this three-year systematic course was successfully implemented for eight trainees, two of whom were from the TC region (Lao PDR and Thailand).

Figure 20　Training course opening ceremony attendees

(KRA1, 2, 6, 7)

e. Regional Cooperation Achievements/Results

e-1. Flood Hazard Mapping Project

In the Flood Hazard Mapping Project, Typhoon Committee member countries are called on to make efforts to reduce damage, particularly that related to humans, caused by flood disasters resulting from typhoons. To this end, it is essential that flood forecasts and warnings and evacuation advisories and directives be made as functional and effective as possible. Accordingly, improving the accuracy and dissemination of flood forecasts and warnings is of extreme importance, as is the creation of flood hazard maps providing knowledge of flood risks and clarifying the point at which evacuation is required. The synergetic effects of these efforts are expected to lead to voluntary and rapid evacuation when necessary.

The year 2009 marks the final part of a three-year extension of these efforts. The WS, which was held in Cebu in the Philippines as a pre-meeting on September 13 and as a WHG workshop from September 14 to 18, confirmed the related activities undertaken over the past eight years and also discussed the draft final report for the whole project.

First, Japan, which has provided leadership in the FHM project, outlined the activities of member countries and highlighted the key achievements of the project. In response, China, the Philippines, Vietnam and other members made comments to reflect latest efforts of each country. After the workshop, each country confirmed the content of the final report, and participating members presented knowledge and obtained know-how from each other. The achievements of the FHM project include actual recommendations for water-related disaster prevention.

The lessons learned from the project were summarized as follows in the final report:

I. Effectiveness of FHM

1) FHM is an essential countermeasure to reduce flood damage at national/local/individual level.
2) FHM can be effective within shorter-period of time, while structural measures such as embankment or dams need a longtime to be constructed.
3) The most suitable FHM for a certain area can be built-up, combining topographic map, past flood investigation, inundation analysis and required data.

II. Role of the central government

1) To reduce human/economic losses, FHM should acquire a primary position in national disaster prevention policy.
2) Through the FHM project, a right perception on supposed disaster and facilities' capacity shall be recognized in local society.
3) For popularization of FHM, the central government is expected to set up a legal regulation, immediate target and technical domestic support system.

III. Action in local community

1) Local government/NGO shall connect flood fighting services and residents by FHM, and brush it up by referring to many activities in other regions.
2) Residential collaborative action of information/experience sharing is a key factor of FHM to ensure the local livelihood sustainability.
3) FHM work may become a culture to live in flood-prone area through identification of area-specific dangers, resources and warning messages.

（KRA1, 2, 6, 7）

f. Identified Opportunities/Challenges for Future Achievements/Results

6. Progress on Key Result Area 6: Improved Capacity to Generate and Provide Accurate, Timely, and understandable Information on Typhoon-related Threats.

a. Meteorological Achievements/Results

a-1. Improvement of Observation Systems

Radar observation

Five Conventional Radars Replaced with Doppler Radars by JMA

JMA operates 20 weather radars that are designed to collectively cover the whole areas around Japan to observe the development of precipitation systems three dimensionally, and in 2006 JMA began replacements of conventional radars with new Doppler radars. By April 2010, 5 conventional radars, those at Sapporo, Fukui, Osaka, Hiroshima and Ishigakijima, will be newly replaced with Doppler radars in addition to the existing 11 Doppler radars that are already operating. After April 2010, the network of those 16 Doppler radars will contribute to disaster prevention through the provision of detailed meteorological information about strong wind and through the incorporation of the data into Numerical Weather Prediction to give more accurate products.

Interval of Weather Radar Observation Shortened

In response to the extensive damage caused by a series of local heavy rains in many parts of Japan during the summer of 2008, JMA shortened the observing interval of weather radars from 10 to 5 minutes in July 2009 with the aim of early detection of developing precipitation cells which may bring local heavy rainfall. This shortening was made possible after we reorganized the scan sequence of each of the 20 countrywide weather radars, and as a result we can produce the nationwide radar-echo composite maps every 5 minutes. Those maps are used in real-time by JMA for issuing weather warnings and also provided to the general public through the JMA website.

Upper-air observation

Change in the Wind-finding Method of Radiosondes in Japan

Upper-air observation by radiosondes in Japan is now carried out through two different wind-finding methods – one involving radio theodolites and the other involving GPS (Global Positioning System) using satellites.

JMA is planning to introduce the GPS wind-finding method to all 16 of its observation sites by March 2010 to improve data acquisition and accuracy.

The Agency will also install an integrated system that gathers all data at its headquarters in order implement quality control more effectively for advanced use of the data.

Satellite observation

Switchover of Meteorological Mission from MTSAT-1R to MTSAT-2

Since 1977, JMA has been operating a series of geostationary meteorological satellites *Himawari* (meaning “sunflower” in Japanese). The imagery data they produce are used for observing and forecasting weather and contributing to disaster prevention, and are particularly crucial in typhoon analysis.

At present, JMA operates an imaging function on Multi-functional Transport Satellite-1R (MTSAT-1R, also known as Himawari-6), which has been in geostationary orbit at 140 degrees east since 28 June 2005. The satellite observes the Northern Hemisphere every 30 minutes and the Southern Hemisphere on an hourly basis.

After the imager on board MTSAT-1R reaches the end of its operational life, JMA plans to switch its imaging function to MTSAT-2 (also known as Himawari-7), which is placed in geostationary orbit at 145 degrees east and is now on stand-by, on 1 July 2010. The geostationary orbiting positions of MTSAT-1R and -2 will not change, and cloud imagery will be acquired from 145 degrees east after the switchover.

MTSAT-2's imager carries one visible and four infrared channels in the same way as MTSAT-1R. The spectral characteristics of both satellites’ imagers are almost identical, and their spatial and quantization resolutions are the same. As the observation timetable of MTSAT-2 will be also the same as that of MTSAT-1R, it will continuously provide similar information on typhoon observation.

Regarding the HRIT/LRIT image dissemination service for MDUS/SDUS provided by the satellite, MTSAT-1R will deliver MTSAT-2's images after the switchover, meaning that MDUS and SDUS users will not need to reposition receiving antennas. After the switchover, full-disk visible images will be additionally disseminated on LRIT.

(KRA1, 2, 4, 5)

a-2. Improvement of the Global Telecommunication System

Three regional and interregional circuits connected with RTH Tokyo migrated from Frame Relay services to an MPLS-based IP-VPN in March 2009 in order to avoid interruption of GTS operation due to the discontinuation of the Frame Relay service. The migration plan was coordinated by RTH Tokyo in cooperation with RTH Bangkok and NMCs Hong Kong and Manila. In addition, two Main Telecommunication Network (MTN) circuits connecting RTH Tokyo with WMCs Washington and Melbourne also migrated to the RA-VI Regional Meteorological Data Communication Network (RMDCN), which is operated over an MPLS based IP-VPN, in September and November 2009, respectively.

(KRA1, 2, 4, 5, 7)

a-3. Upgrade of the Operational Mesoscale 4D-Var System

On 7 April 2009, the operational mesoscale analysis system was upgraded. The previous version was a four-dimensional variational data assimilation system (Meso 4D-Var) based on a hydrostatic spectral model that used to act as a forecast tool for the Meso Scale Model (MSM). The forecast model was upgraded from this hydrostatic spectral model to a nonhydrostatic grid model (NHM) in September 2004, since which time there had been a need to develop a new 4D-Var based on JMA-NHM. This new 4D-Var, named JNoVA, was introduced to replace the Meso 4D-Var system. This upgrade also includes enhancement of the analysis resolution from 10 km to 5 km horizontally and from 40 to 50 layers vertically. Twin month-long experiments both in summer and in winter showed that quantitative precipitation forecasts (QPFs) were improved significantly by initializing the NHM with JNoVA rather than with Meso 4D-Var (Fig. 21). In the case of Typhoon Wukong in 2006, the improved typhoon track forecast led to better forecasting of precipitation patterns (Fig. 22). The upgrade of the analysis system is expected to contribute significantly to enhancing the accuracy of meteorological advisories/warnings and aviation forecasts.

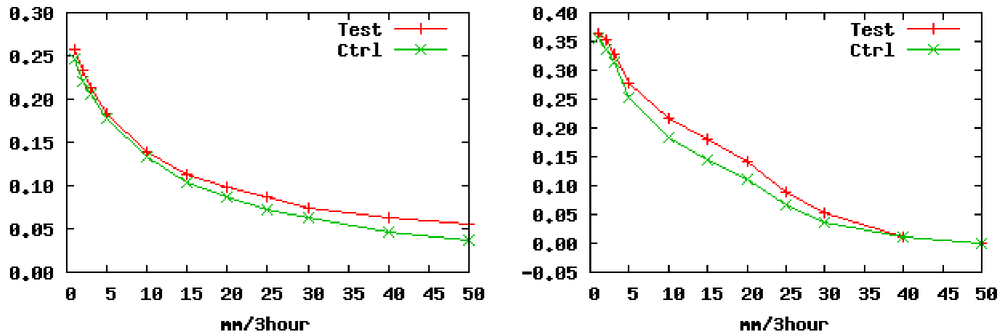


Figure 21 Equitable threat scores of three-hourly accumulated precipitation forecasts in summer (right) and winter (left). The red and green lines show the results of JNoVA (Test) and Meso 4D-Var (CTRL), respectively. The horizontal axis represents the threshold values of the rainfall amount.

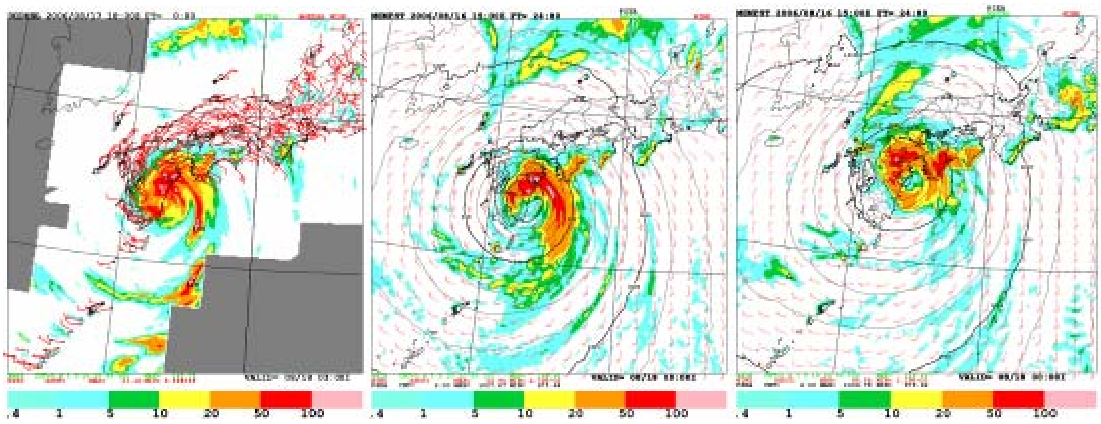


Figure 22 Three-hourly accumulated precipitation of 24-hour forecasts from the 15 UTC initial time on 17 Aug. 2006. From the left, analyzed precipitation, the forecast of JNoVA and that of Meso 4D-Var are shown.

(KRA1, 2, 4, 5, 7)

<u>a-4. Improvements to JMA's Typhoon Ensemble Prediction System (TEPS)</u>

In June 2009, the Japan Meteorological Agency (JMA) upgraded the forecast model used for its Typhoon Ensemble Prediction System (TEPS). This model is a low-resolution version (TL319L60, approximately 60 km horizontally and 60 layers up to 0.1 hPa) of JMA's Global Spectral Model (GSM). In this upgrade, a new dynamical core and a number of calculation modifications were introduced into the low-resolution GSM. The core uses a reduced Gaussian grid and is being used in JMA operational high resolution GSM. The impact of the upgrade was investigated through forecast experiments from 20 August to 9 October 2008. The ensemble mean track forecast error of tropical cyclones (TCs) in RSMC Tokyo's area of responsibility was reduced as a result of the enhancement (Figure 23).

The TEPS upgrade is expected to contribute to improving the accuracy of TC forecasts.

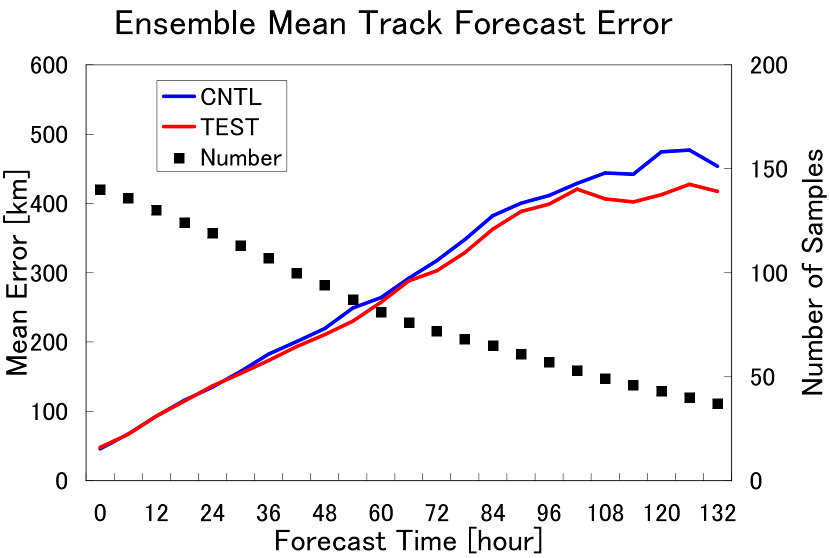


Figure 23 Ensemble mean track forecast error (km) of TCs in RSMC Tokyo's are of responsibility from 20 August to 9 October 2008. The blue and red lines show the error of TEPS with the old dynamical core (a standard Gaussian grid) and that with the new dynamical core (a reduced Gaussian grid), respectively. The black dots denote the number of verification samples.

(KRA1, 2, 4, 5, 7)

a-5. Weekly report on extreme climate events

JMA issues the weekly reports on extreme climate events around the world, including extremely heavy precipitation and/or weather-related disasters caused by tropical cyclones. These reports are distributed to NMHSs via the TCC website in near-real time (http://ds.data.jma.go.jp/gmd/tcc/tcc/products/climate/).

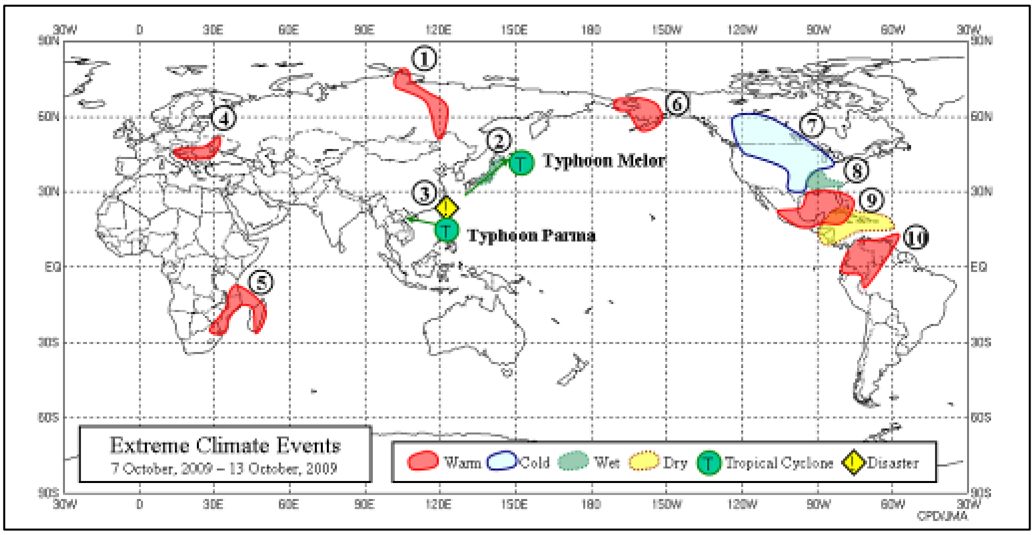


Figure 24 Distribution of global extreme climate events (7 Oct 2009 - 13 Oct 2009); The figure indicates areas where extreme climate events were identified from SYNOP messages, and also shows the tracks of tropical cyclones based on preliminary data from Tropical Cyclone Centers worldwide.

（KRA1, 2, 4, 5, 7）

b. Hydrological Achievements/Results

b-1. Approach of the International Flood Network (IFNet) and the Global Flood Alert System (GFAS)

(1) IFNet and GFAS

IFNet operates the Global Flood Alert System (GFAS) - a project offering the information needed to rank the risk of flood occurrence utilizing satellite observation of rainfall amounts. GFAS began automatic distribution of information in June 2006, and uses IFNet to suply rainfall information and flood occurrence probability (flood possibility) statistics based on global rainfall data observed every three hours by multiple earth observation satellites. This is considered to provide valuable information for flood forecasting and warnings in areas along large rivers, where it takes several days for data on rainfall in upstream areas to reach downstream regions where telemeter systems have not been developed, or in international rivers where it is difficult to transmit information on upstream areas to downstream regions. GFAS offers two types of services - one providing basic information and the other providing customized information.

(2) The 5th IFNet General Meeting

The 5th IFNet General Meeting was held on Thursday, 19 March in Istanbul, Turkey, in conjunction with the 5th World Water Forum.

Following a complimentary address by Mr. Hiroaki Taniguchi, Vice Minister for Engineering Affairs at the Japanese Government's Ministry of Land, Infrastructure, Transport and Tourism (MLIT), the meeting itself was chaired by Mr. Avinash C. Tyagi, Director of WMO's Climate and Water Department. The event was closed by Vice Chairperson Mr. Toshiyuki Adachi, Director of the River Planning Division at MLIT.

At this meeting, IFNet members discussed the following three matters:

1) A report of activities following the Asia-Pacific Water Summit in December 2007 in Beppu, Japan
2) Introduction of the Global Flood Alert System utilizing satellite-based rainfall data to mitigate flood damage
3) The activities of the Typhoon Committee Working Group on Hydrology


Figure 25　Discussion at the meeting

(3) GFAS Validation Workshop

IFNet and the International Centre for Water Hazard and Risk Management（ICHARM） ran the International Workshop on Application and Validation of GFAS from August 3 to 7, 2009.

Six participants in charge of water-related disaster prevention in their countries (Bangladesh, India, Indonesia, Lao PDR, Nepal and Vietnam) gathered at ICHARM in Tsukuba, Japan.

Information necessary for GFAS was provided in a series of intensive lectures:

- Flood Forecasts and Hydrological Observation in Japan, by Mr. Fukami, ICHARM
- Applicability of Satellite Rainfall Data, by Dr. Oki and Dr. Kachi, JAXA
- Introduction of GFAS and IFNet, by Mr. Matsuki: IDI
- Result of Comparison between Satellite and Ground-based Rainfall Data, by Mr. Ito, IDI
- Presentations on water-related disaster prevention, by all participants
- Introduction of IFAS, by Mr. Sugiura, ICHARM
- Introduction of Modification Method of Satellite-based Rainfall, by Mr. Ozawa, ICHARM
- Introduction of GIS data, by Dr. Magome, ICHARM
- Example of IFAS Operation in Japan and its Validation Result, by Mr. Sugiura, ICHARM
- IFAS Training using Example Data, by Mr. Sugiura, ICHARM
- Introduction of IFAS (BTOP model), by Dr. Magome, ICHARM

A field trip in the Tokyo area was also conducted. The workshop resulted in enhanced GFAS/IFAS operation know-how among all participants, who confirmed their commitment to helping with GFAS/IFAS upgrade work in the future.


Figure 26　Workshop participants

（KRA1, 2, 4, 5）

b-2. Promotion of Countermeasures for Localized Heavy Rainfall and Extremely Intensified Rainfall -Introduction of X-band MP Radars-

In recent years, serious disasters caused by localized heavy rainfall and extremely intensified rainfall have become increasingly frequent throughout Japan.

To strengthen real-time monitoring of these types of rainfall, the Ministry of Land, Infrastructure, Transport and Tourism has started a project to implement more detailed, frequent monitoring by introducing X-band MP (multi-parameter) radars. This new type is capable of observing rainfall with higher frequency, finer resolution and improved accuracy, and can also observe 3D distribution of rainfall and wind. The radars are expected to improve accuracy in observation and forecasting of localized heavy rainfall, which is often found difficult to observe with traditional C-band radars.

X-band MP radars enable observation of wind and even the shape of raindrops. This sophisticated capability leads to technological research and development for observation and forecasting of thundercloud development and rainfall-area movement as well as for improved flood forecasting and simulation. With these technological improvements, more accurate and timely information can be provided to the relevant municipalities and local residents, which will contribute to the reduction of damage caused by localized heavy rainfall or extremely intensified rainfall.

Under the current plan, a total of 11 X-band radar stations will be implemented in three metropolitan areas and other regions (Kanto, Chubu, Kinki and Hokuriku) by the end of fiscal 2009, and in the regions of Chugoku and Kyushu in the near future. Test operation is scheduled to start in fiscal 2010 before full operation in 2013.

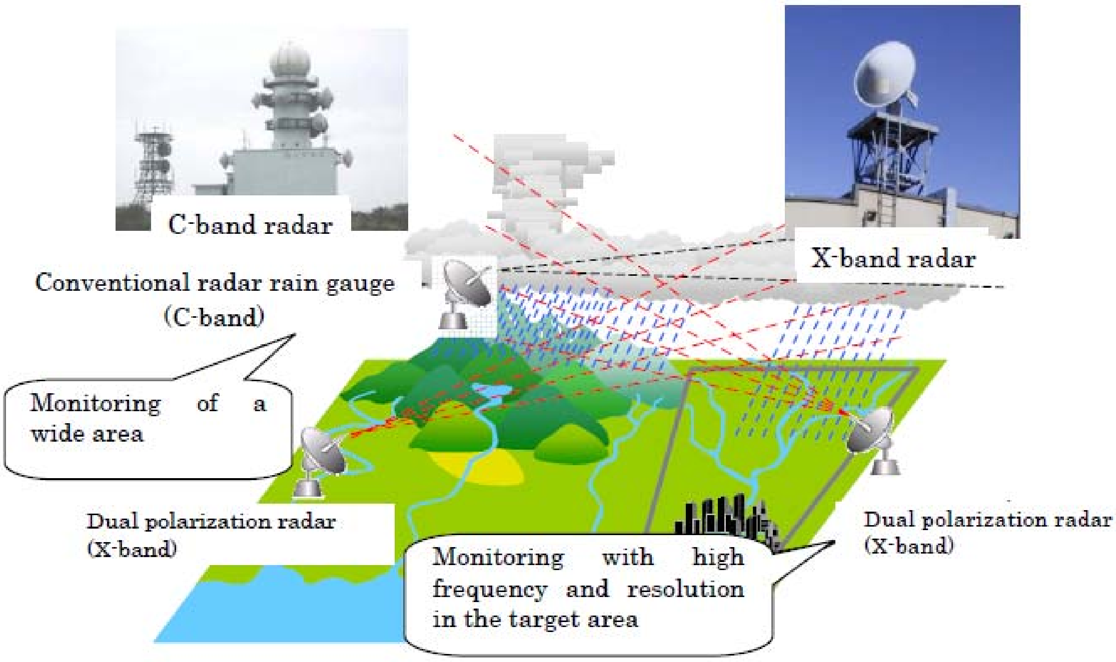


Figure 27 Rainfall observation by X-band radars

Radar type	C-band radar (conventional type)	X-band MP radar (new type)
Frequency band, wavelength	4 – 8 GHz, 5 cm	8 – 12 GHz, 3 cm
Observational purpose	Real-time rainfall monitoring for river management (over a wide area)	- Real-time rainfall monitoring for river management (over a limited area for detailed data) - Observation of rainfall area development and movement
Observational period	5 minutes	1 minute (target duration)
Time-lag to information release	5 – 10 minutes	1 – 2 minutes (target time-lag)
Resolution of data	1 km	250 – 500 m
Doppler observation (wind observation)	Partially conducted	Fully conducted
Scanning method	2D scanning	3D scanning (observation of raindrop formation process)
Dual polarization (observation of raindrop shape)	Partially conducted	Fully conducted

Table 2 Specifics of C-band and X-band radars

(KRA1, 2, 4)

b-3. Establishment of “Forecasting Centers for Water-related Disasters”

In recent years, water-related disasters have become more frequent, including storm surge and flooding events caused by record heavy rainfall and localized intensive deluges. This situation requires river administrators and municipal offices to provide faster and more precise disaster response. Efforts should also be made to achieve the goal of ensuring zero disaster victims by analyzing, assessing and appropriately incorporating the impacts of external forces intensified by climate change due to global warming into structural and non-structural measures.

Accordingly, “Forecasting Centers for Water-related Disasters” were established in April 2009, and have since been in operation at the eight MLIT Regional Development Bureaus across Japan. The Centers provide the following services:

1. Monitoring and forecasting of water-related disasters and improvement of these functions
2. Collection and dissemination of information on monitoring, forecasting, forecasts and warnings, and water levels
3. Analysis and assessment of the impacts of climate change on water-related disasters
4. Assistance for prefectural river administrators and flood-fighting administrators

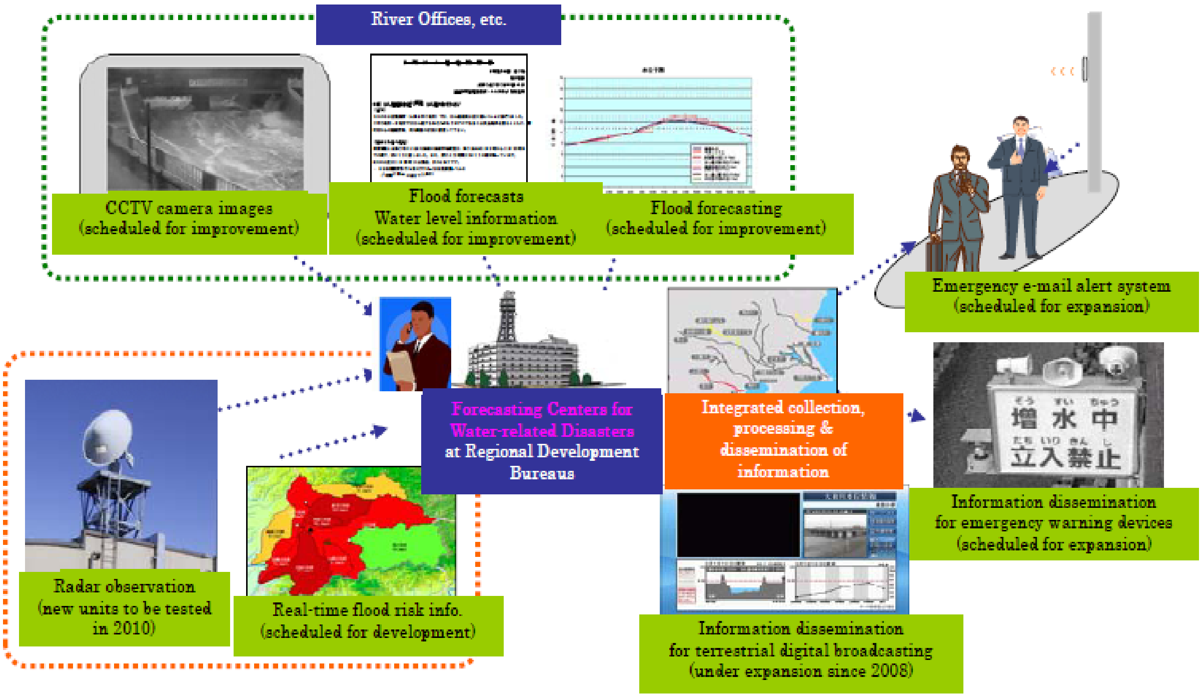


Figure 28　Forecasting Centers for Water-related Disasters

(KRA1, 2, 4)

c. Disaster Prevention and Preparedness Achievements/Results

d. Research, Training, and Other Achievements/Results

d-1. Training Seminar on Climate Information and Forecasting

A Training Seminar on Climate Information and Forecasting was held at JMA Headquarters in Tokyo from 4 to 6 November 2008. The event was attended by 13 participants from 12 countries and regions engaged in operational long-range forecasting at NMHSs in East and Southeast Asia, including 8 members of the Typhoon Committee. Through lectures and exercises using PCs, the participants learned how to use the data and products available on the TCC website for long-range forecasting. Presentation files used in the seminar are also available on the site, which can be found at http://ds.data.jma.go.jp/tcc/tcc/library/library2008.html.

Figure 29　Training seminar participants

d-2. Reanalysis Project for Typhoon Vera (1959): ReVera

1. Introduction

Fifty years ago, Typhoon Vera (1959) made landfall on Japan's Kii Peninsula at around 1800 JST(0900 UTC) on 26 September 1959. It brought tremendous damage to the country's islands – especially around the Ise Bay area – and was the most tragic meteorological disaster in post-war Japan with a casualty toll exceeding 5,000. The massive damage it caused to society means that Vera is well remembered in Japan, and people recall it as the Isewan (Ise Bay) Typhoon. At the time, the one-day track forecast for Vera was accurate, but the forecast for its speed of movement suggested that it would be much slower than it actually was. In addition, the forecast of storm surge around Ise Bay was 100 to 150 cm at most – much lower than the actually recorded value of 389 cm.

Recent advances in objective numerical reanalysis systems have enabled us to obtain long-term reanalysis data. JMA has started the JRA-55 project (a long-term reanalysis initiative targeting the period from 1958 to 2012), which is the successor of the JRA-25 project for the period from 1979 to 2004. Using the reanalysis dataset and sophisticated numerical models, we can simulate past remarkable meteorological phenomena such as typhoons. Accordingly, we performed numerical prediction experiments for Vera to validate its predictability using the latest forecast techniques together with the primary outcome from JRA-55 as initial conditions for track, intensity and storm surge predictions.

2. Track forecast experiment

We performed track predictions using the global model with a horizontal grid spacing of 60 km and different initial conditions every 12 hours starting from 4 days before Vera made landfall. In all the simulated cases, Vera was predicted to make landfall in Japan. Among the forecasts, the one with an initial time of 0900 JST on 24 September 1959 showed the outcome closest to the best track. Then, ensemble forecasts with 11 members were performed by perturbing the initial conditions using the same time. The results (Figure 30) indicate that all the members predicted realistic tracks making landfall in Japan, with the locations of landfall widely distributed across southern coastal areas of the country. However, the tracks were less varied and stayed close to the best track until Vera passed the 30°N point.

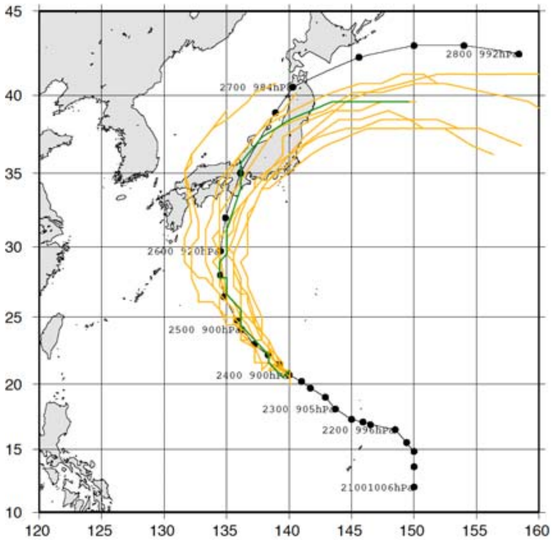


Figure 30 Track forecast results from the global ensemble model with 11 members. The line with the dots shows the best track. The green line is a control run, and the yellow lines are derived from the ensemble members.

3. Intensity and storm surge experiment

To predict the intensity of Vera and the associated storm surge more accurately, a high-resolution mesoscale model was needed to make the initial conditions as realistic as possible. For this purpose, JNoVA (JMA's Non-hydrostatic model Variational data Assimilation system) was used to implement mesoscale analysis for a period of 24 hours from 0900 JST on 25 September 1959 with a 3-hour assimilation window. We also assimilated dropsonde data for Vera obtained through US military aircraft reconnaissance and archived at JMA. We performed 36-hour forecast experiments using the results of this analysis and the non-hydrostatic model with a grid spacing of 5 km from 0900 JST on 26 September, 1959 (9 hour before the landfall). Figure 31 shows the results of the numerical experiment; it indicates that Vera makes landfall on the Kii Peninsula, and the amount of precipitation was successfully simulated. In addition, the time difference of landfall between the simulation and the analysis based on the best track is less than an hour. Figure 32 shows a pseudo-satellite image artificially produced from the output of the numerical simulation. Such realistic imagery was not available 50 years ago because the first geostationary meteorological satellite (GMS) over the western Pacific was launched in 1977.

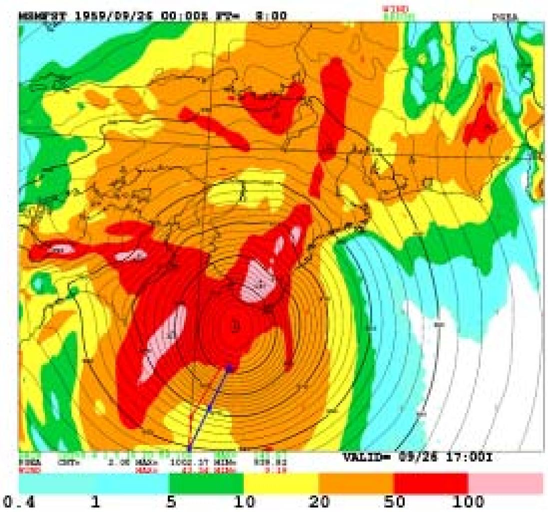


Figure 31 Intensity forecast for Vera created using JMA's non-hydrostatic model at 17 JST on 26 Sep., 1959. The colors represent three-hourly cumulative rainfall values, and the contours indicate surface pressure.

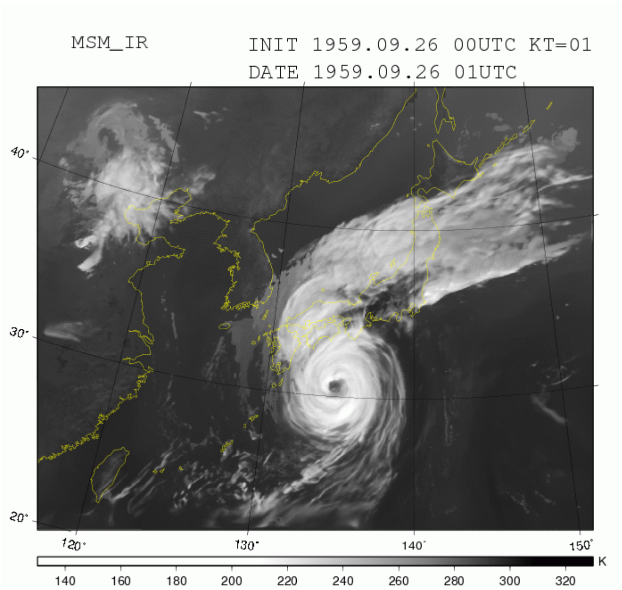


Figure 32 Pseudo-satellite image of Vera simulated by JMA's non-hydrostatic model

After the numerical simulation using the mesoscale model, storm surge predictions were performed using the Princeton Ocean Model and the output from the numerical simulation as atmospheric forcing. The predicted sea-level height at the port of Nagoya was very close to the observed value (Figure 33).

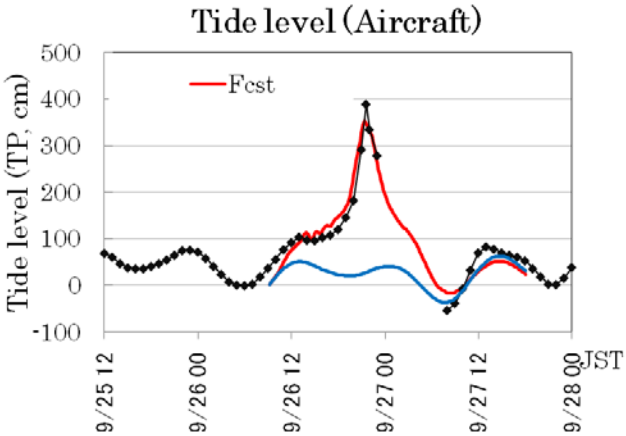


Figure 33 Storm surge observation and forecast for the port of Nagoya. The red line shows the forecast results, the blue line indicates the astronomical tide level, and black line with dots plots the observed values.

4. Summary

From these experiments, it is deemed possible to obtain highly accurate predictions for Vera using the latest forecast techniques. An important consideration of this outcome is that the numerical model used in the present experiments is based on the operational version at JMA, suggesting high potential to predict the tracks and intensity of large typhoons such as Vera using the current operational prediction system.

(KRA1, 2, 4, 5)

e. Regional Cooperation Achievements/Results

f. Identified Opportunities/Challenges for Future Achievements/Results

7. Progress on Key Result Area 7: Enhanced Typhoon Committee's Effectiveness and International Collaboration.

a. Meteorological Achievements/Results

<u>a-1. Designation of TCC as a WMO Regional Climate Center</u>

JMA's Tokyo Climate Center (TCC) was established with the aim of promoting the application of climate information in various fields, including the prevention of disasters due to extreme climate events, agricultural production planning and water resource management in the Asia-Pacific Region. TCC provides National Meteorological and Hydrological Services (NMHSs) in this region with basic climate data and products through its website; these include long-range forecast products, El Niño monitoring and outlook reports, world climate monitoring, climate system monitoring and global warming projection. The Center also provides capacity-building activities through seminars and hands-on training to assist NMHSs with climate information services. In recognition of its contribution to climate services in the region, TCC was designated as one of the first WMO Regional Climate Centers (RCCs) together with the China Meteorological Administration's Beijing Climate Center.

(KRA1, 2, 4, 5）

a-2. TCC News

TCC issues a quarterly newsletter called *TCC News*, which is available on the TCC website. It covers various climate-related topics including the El Niño outlook, JMA's seasonal numerical prediction for the coming summer/winter, summaries of Asian summer/winter monsoons, reports on extreme climate events around the world, and introductions to new TCC new services. The latest issue, *TCC News No. 18*, covers a topic on heavy precipitation caused by two tropical cyclones in the Philippines from late September to early October (http://ds.data.jma.go.jp/tcc/tcc/news/tccnews18.pdf).

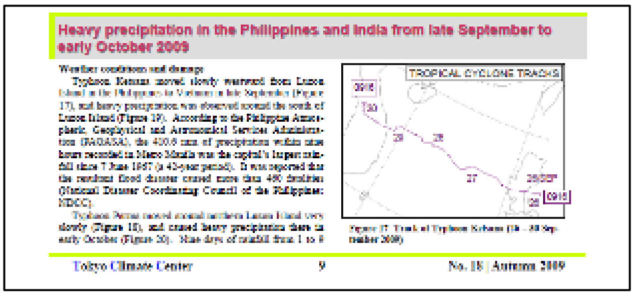


Figure 34 TCC News

(KRA1, 2, 4, 5）

b. Hydrological Achievements/Results

b-1. Japan-China-ROK Trilateral Joint Announcement on Water Management Cooperation

The ministers responsible for water resources of Japan, the People's Republic of China and the Republic of Korea shared their views on the importance of promoting trilateral cooperation in the field of water management at the 5th World Water Forum held in Istanbul, Turkey in March 2009.

In the second Japan-China-ROK Trilateral summit meeting on 10 October 2009 in Beijing China, the heads of the government agreed to establish a mechanism for meeting of ministers responsible for water resources in due course, focusing on integrated river management and water resources management adapting to climate change.

c. Disaster Prevention and Preparedness Achievements/Results

c-1. First Japan-China-Korea Trilateral Heads of Government Agency Meeting on Disaster Management

The heads of government agencies dealing with disaster management in Japan, the People's Republic of China and the Republic of Korea held the first commemorative Trilateral Meeting on Disaster Management in Kobe, Japan on 31st October 2009 to strengthen cooperation on disaster management among the three countries.

At the meeting, the participating nations confirmed the need to continue related efforts and to strengthen trilateral cooperation on disaster management. They restated their mutual intent to share information on the areas outlined below with cooperation from the relevant government agencies in each country. The three nations also affirmed the need to collectively promote research and other efforts on specific areas in which they reached consensus through the process of sharing information.

(1) Sharing information and technology on the countermeasures to the disasters which are expected to increase due to climate change, and deepening discussion on future technological developments and their utilization among the three countries;

(2) Discussing the future cooperation to promote earthquake-proofing of buildings in the three countries by sharing information on the current efforts and other information on earthquake-proofing of buildings;

(3) Promoting the information sharing on the current efforts by the three countries to utilize satellite technologies for disaster management, and, from the viewpoint of humanitarian concern in the wake of disasters, discussing the possibility of cooperation for more efficient and effective operations of utilizing satellite images.

The member nations also reaffirmed their intent to discuss ways to promote further information sharing regarding knowledge, experience and lessons learned from past disasters in the three countries.

The participants additionally exchanged views on further trilateral efforts for disaster management in the following areas with cooperation among the relevant government agencies of each country:

(1) Holding expert-level seminars on the training for human resources of disaster management and sharing expertise in this field including training curricula, in light of the importance of human resources development in disaster management;

(2) Strengthening cooperation with international disaster management organizations located in the three countries and in international disaster management conferences to be held in the three countries.

These agreements were enshrined in the Trilateral Joint Statement on Disaster Management Cooperation, which was signed by the heads of the government agencies in charge of disaster management in the three countries.

c-2. Urban Search-and-Rescue Training in Singapore as an ADRC Disaster Mitigation Activity

The Singaporean government holds a training course every year for search-and-rescue officers. The course has been receiving trainees from outside Singapore for the past eight years and providing training on search-and-rescue expertise required in urban disaster situations. The training facility complex of the Civil Defence Academy (CDA) inder the Singapore Civil Defence Force (SCDF) is among the best of its kind in Asia, and as part of efforts to utilize its expertise and facilities, the Asian Disaster Reduction Center (ADRC) has been inviting relevant officers from member countries to the training course since 2001. Officers from the Kingdom of Bhutan, the Republic of Kazakhstan, Mongolia, and the Kingdom of Thailand participated in this year’s course from 5 to 16 January 2009 (two weeks).

Figure 35 Urban search-and-rescue training in Singapore

d. Research, Training, and Other Achievements/Results

d-1. Ninth Typhoon Committee Training Seminar at the RSMC Tokyo - Typhoon Center

The RSMC Tokyo - Typhoon Center assumes the responsibility of assisting members of the ESCAP/WMO Typhoon Committee with typhoon forecasting services. One of the activities of the Center is to hold on-the-job training on typhoon operations for forecasters in the region to improve analysis and forecast skills by exchanging views and sharing experiences in the field.

This year, two forecasters – Ms. Huang Bin from China (China Meteorological Administration) and Ms. Marcella James J. from Malaysia (Malaysia Meteorological Department) – visited the Japan Meteorological Agency (JMA) from 22 to 31 July 2009 to participate in the ninth Typhoon Committee Training Seminar at the RSMC Tokyo - Typhoon Center. Through the course, the two forecasters learned about tropical cyclone analysis and forecasting, and in particular about analysis using SATAID software (a satellite viewer program).

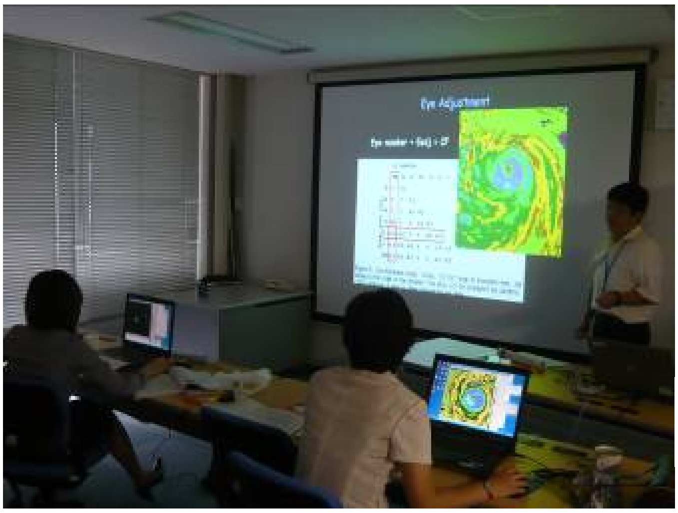


Figure 36 Ninth Typhoon Committee Training Seminar

(KRA1, 2, 4, 5, 6）

d-2. *The Reinforcement of Meteorological Services* group training course

JMA conducted the Reinforcement of Meteorological Services group training course as one of the Training and Dialogue Programmes of the Japan International Cooperation Agency (JICA) from 24 September to 14 December 2009. The session was one of a series of JICA group training courses in meteorology that have been provided since 1973 to support capacity building among National Meteorological Services. On the course, eight participants from eight countries (including Cambodia and Myanmar from among the TC members) acquired skills in the utilization of satellite data including nephanalysis and tropical-cyclone analysis, and learned about the application of numerical weather prediction products and radar data. The course also included technical tours to private weather companies, airlines and mass media in charge of disaster prevention/mitigation and risk management to highlight state-of-the-art application and communication of meteorological information.

(KRA1, 2, 4, 5, 6）

d-3. *The Capacity Development for Adaptation to Climate Change in Asia* group training course

JMA’s Meteorological Research Institute (MRI) implemented the Capacity Development for Adaptation to Climate Change in Asia group training course as one of the Training and Dialogue Programmes of the Japan International Cooperation Agency (JICA) from 22 May to 16 June 2009. On this course, five meteorologists (including staff members from the meteorological services of the Philippines, Thailand and Vietnam from among the TC members) worked on the analysis of 20-km mesh MRI/JMA Atmospheric General Circulation Model (AGCM) results obtained using the Earth Simulator in order to investigate the current issues of climate change projection in their respective countries.

(KRA1, 2, 4, 5, 6）

d-4. International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO

ICHARM, established on 3 March 2006 under an agreement by the Japanese government, UNESCO and the Public Works Research Institute, actively promotes various activities toward better management for water-related disasters. Although ICHARM's scope is global, many of its activities target the Asia-Pacific region, including TC members.

ICHARM initially places priority on risk management in relation to flood-related disasters, including those induced by typhoons. Training, research and information networking are the three pillars of ICHARM activities to produce the best practicable strategies for diverse localities worldwide and assist in their implementation.

Below are some notable ICHARM activities during the past year.

Update on ICHARM's progresses

1) Training
   - i) One-year master's course program on Water-related Disaster Risk Reduction (in collaboration with GRIPS and JICA since Oct. 2007)
   - ii) Local Disaster Management with Flood Hazard Maps training course (launched in 2009 in collaboration with JICA)

2) Research
   - i) Development of IFAS (Integrated Flood Analysis System)
   - ii) Research on global trends of water-related disasters

3) Information Networking
   - i) Fulfillment of role as secretariat of the International Flood Initiative (IFI) - a joint initiative of UNESCO, WMO, UN/ISDR and UNU
   - ii) Contribution to enrichment of the disaster management chapter of WWAP (the World Water Assessment Programme) launched in March 2009
   - iii) Fulfillment of role as topic coordinator for the "Managing Disasters" topic at the 5th World Water Forum held in March 2009 in Istanbul.
   - iv) Extension of technical assistance to selected Asian countries in collaboration with ADB (launched in Nov. 2009)

Many of the above activities contribute to the enhancement of social, economic, environmental and institutional aspects of disaster risk reduction in the TC region. ICHARM also provides related information on its website at http://www.icharm.pwri.go.jp/.

(KRA1, 2, 3, 4, 5, 6）

e. Regional Cooperation Achievements/Results

e-1. Expert services of the Japan Meteorological Agency (JMA)

- Two JMA experts visited the Hong Kong Observatory in February 2009, to give lectures at the numerical weather prediction/nowcasting workshop. The workshop was attended by participants from China, Viet Nam and Macau.

- Two JMA experts visited the Malaysian Meteorological Department in June 2009, as trainers for the workshop on marine forecasting models for storm surge, wave and oil spill.
- Two JMA experts visited the Korea Meteorological Administration in September 2009 for sharing experience on radar operation systems to help improve the systems in the Republic of Korea.

e-2. Technical visits to JMA

- A numerical weather prediction expert from the Malaysian Meteorological Department visited JMA for technical exchange on JMA's non-hydrostatic model in September 2009.
- A numerical weather prediction expert from the Hong Kong Observatory visited JMA for technical exchange on JMA's non-hydrostatic model and its 3D variational data assimilation system in January 2010.

f. Identified Opportunities/Challenges for Future Achievements/Results

III. Resource Mobilization Activities

1. A basic design study for the project to upgrade the radar system in the Philippines

The government of Japan has exchanged a letter with the government of Philippines about an agreement on the project named Improvement of the Meteorological Radar System in the Philippines. This is a project for sponsorship by Japan’s Grant Aid program, and is implemented by The Japan International Cooperation Agency (JICA) to support the upgrading of the radar observation system run by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). In this project, three Doppler radars and VSAT system will be installed.

IV. Update of Member’s Working Groups Representatives

1. Working Group on Meteorology

2. Working Group on Hydrology

3. Working Group on Disaster Prevention and Preparedness

4. Training and Research Coordinating Group

5. Resource Mobilization Group