COUNTRY REPORT

7th Typhoon Committee Integrated Workshop

ESCAP/WMO Typhoon Committee

26 - 30 November 2012

China

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 2012, 17 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. Japan was affected by 11 of these, with 2 making landfall. The details of these 11 are described below, and their tracks are shown in Figure 1.

(1) TY Mawar (1203)

Mawar was upgraded to tropical storm (TS) intensity east of Luzon Island in the Philippines at 18 UTC on 1 June. After turning north-northeastward the next day, it was upgraded to typhoon (TY) intensity south of Okinawa Island at 12 UTC on 3 June and reached its peak intensity with maximum sustained winds of 75 kt and a central pressure of 960 hPa at 18 UTC the same day. Accelerating northeastward, it transformed into an extratropical cyclone east of Hachijojima Island at 06 UTC on 6 June. Damage to houses and cancellations of flights and ship departures were reported in Okinawa Prefecture.

(2) TY Guchol (1204)

Guchol was upgraded to tropical storm (TS) intensity east of the Philippines at 12 UTC on 13 June. After turning sharply north-northwestward, it was upgraded to typhoon (TY) intensity east of the Philippines at 00 UTC on 16 June and reached its peak intensity with maximum sustained winds of 100 kt and a central pressure of 930 hPa 12 hours later. Moving northeastward, Guchol made landfall on the southern part of Wakayama Prefecture with TY intensity after 08 UTC on 19 June. Keeping its northeastward track, it transformed into an extratropical cyclone east of Japan at 00 UTC on 20 June.

A peak gust of 41.4 m/s was recorded at Omaezaki (47655), and a 24-hour precipitation total of 324.0 mm was recorded at Owase (47663). One person was killed due to strong winds in Shizuoka Prefecture. Damage to houses and farm products, power outages and transport disruption were also reported across a wide area stretching from Tohoku to Okinawa.

(3) STS Khanun (1207)

Khanun was upgraded to tropical storm (TS) intensity over the sea west of Iwoto Island at 06 UTC on 16 July. Keeping its northwestward track, it reached its peak intensity with maximum sustained winds of 50 kt and a central pressure of 985 hPa over the East China Sea at 18 UTC the next day and then turned northward. Khanun hit the Korean Peninsula on 18 July after crossing Jeju Island and weakened to TD intensity at 00 UTC the next day. Cancellations of flights and ship departures were reported in Okinawa Prefecture.

(4) TY Saola (1209)

Saola was upgraded to tropical storm (TS) intensity east of the Philippines at 00 UTC on 28 July. It was upgraded to typhoon (TY) intensity south of Okinawa Island at 18 UTC on 31 July and reached its peak intensity with maximum sustained winds of 70 kt and a central pressure of 960 hPa 12 hours later. After turning in a counterclockwise direction and circling the area near Taiwan Island, Saola accelerated northwestward and hit the eastern coast of China with TS intensity before 00 UTC on 3 August and then weakened to TD intensity at 06 UTC on the same day. A peak gust of 45.3 m/s and a 24-hour precipitation total of 248.5 mm were recorded at Yonagunijima (47912). Power outages and cancellations of flights and ship departures were reported in Okinawa Prefecture.

(5) TY Damrey (1210)

Damrey was upgraded to tropical storm (TS) intensity west of Minamitorishima Island at 12 UTC on 28 July. Keeping its west-northwestward track after drifting southwestward, it was upgraded to severe tropical storm (STS) intensity north of Chichijima Island at 18 UTC on 30 July and passed Yakushima Island after 06 UTC on 1 August. Moving northwestward, Damrey was upgraded to typhoon (TY) intensity over the Yellow Sea at 00 UTC the next day and reached its peak intensity with maximum sustained winds of 70 kt and a central pressure of 965 hPa six hours later. After hitting the area near the Shandong Peninsula late on 2 August, it turned north-northeastward and weakened to TD intensity at 12 UTC the next day. A peak gust of 34.9 m/s was recorded at Tanegashima (47837), and one person was killed due to high waves. Cancellations of flights and ship departures were reported across an area stretching from Shikoku to Okinawa.

(6) TY Haikui (1211)

Haikui was upgraded to tropical storm (TS) intensity south of Iwoto Island at 00 UTC on 3 August and moved west-northwestward. It was upgraded to severe tropical storm (STS) intensity northwest of Okinawa Island at 12 UTC on 5 August. After moving westward slowly over the East China Sea, Haikui was upgraded to typhoon (TY) intensity and reached its peak intensity with maximum sustained winds of 65 kt and a central pressure of 965 hPa over the same waters at 12 UTC on 7 August. Moving northwestward, it hit eastern China late the same day and weakened to TD intensity at 12 UTC on 9 August. A peak gust of 34.0 m/s was recorded at Nago (47940), and a 24-hour precipitation total of 280.0 mm was recorded at Kumejima (47929). Damage to farm products, power outages and cancellations of flights and ship departures were reported in Okinawa Prefecture.

(7) TY Tembin (1214)

Tembin was upgraded to tropical storm (TS) intensity east of Luzon Island at 06 UTC on 19 August. After turning sharply northward, it was upgraded to typhoon (TY) intensity over the same waters at 06 UTC the next day and reached its peak intensity with maximum sustained winds of 80 kt and a central pressure of 950 hPa six hours later. Turning gradually westward, Tembin again reached its peak intensity with maximum sustained winds of 80 kt and a central pressure of 950 hPa south of the Sakishima Islands at 00 UTC on 23 August. After crossing the southern part of Taiwan Island, turning in a counterclockwise direction and circling, Tembin was downgraded to severe tropical storm (STS) intensity north of the Sakishima Islands at 12 UTC on 28 August. Moving north-northeastward, it transformed into an extratropical cyclone at 12 UTC on 30 August after hitting the Korean Peninsula. A peak gust of 34.5 m/s was recorded at Iriomotejima (47917). Power outages and cancellations of flights and ship departures were reported in Okinawa Prefecture.

(8) TY Bolaven (1215)

Bolaven was upgraded to tropical storm (TS) intensity west of the Mariana Islands at 06 UTC on 20 August. Turning west-northwestward, it was upgraded to typhoon (TY) intensity over the same waters at 12 UTC on 21 August. Bolaven reached its peak intensity with maximum sustained winds of 100 kt and a central pressure of 910 hPa south of Minamidaitojima Island at 12 UTC on 25 August. It passed around Okinawa Island with TY intensity around 12 UTC the next day. While moving north-northwestward over the East China Sea and the Yellow Sea, Bolaven weakened slowly before hitting the northern part of the Korean Peninsula late on 28 August. Moving northeastward, it transformed into an extratropical cyclone over northeastern China at 06 UTC the next day. A peak gust of 42.7 m/s and a 24-hour precipitation total of 433.0 mm were recorded at Okinoerabu (47942). Damage to houses and farm products, power outages and transport disruption were reported in Kyushu and Okinawa.

(9) TY Sanba (1216)

Sanba was upgraded to tropical storm (TS) intensity north of the Palau Islands at 00 UTC on 11 September. Moving northwestward, it developed rapidly and was upgraded to typhoon (TY) intensity at 12 UTC the next day. After turning northward, Sanba reached its peak intensity with maximum sustained winds of 110 kt and a central pressure of 900 hPa east of the Philippines at 18 UTC on 13 September. Keeping its northward track, it passed around Okinawa Island with TY intensity at around 22 UTC on 15 September. Sanba continued moving northward over the East China Sea and hit the Korean Peninsula early on 17 September. It was downgraded to severe tropical storm (STS) intensity at 06 UTC the same day while moving across the peninsula. Sanba moved north-northeastward over the Sea of Japan and transformed into an extratropical cyclone at 00 UTC on 18 September soon after hitting Russia. A peak gust of 51.4 m/s was recorded at Nago (47940). Two people were killed due to strong winds and high waves in the prefectures of Nagasaki and Okinawa. Damage to houses and farm products, power outages and transport disruption were also reported across a wide area stretching from Tokai to Okinawa.

(10) TY Jelawat (1217)

Jelawat was upgraded to tropical storm (TS) intensity east of the Philippines at 18 UTC on 20 September. After moving southwestward, it was upgraded to typhoon (TY) intensity at 00 UTC on 23 September before turning north-northwestward. Jelawat developed rapidly and reached its peak intensity with maximum sustained winds of 110 kt and a central pressure of 905 hPa over the same waters at 18 UTC the next day. After recurving south of Ishigakijima Island, it accelerated northeastward on 28 September and made landfall on the eastern part of Aichi Prefecture with TY intensity at around 10 UTC on 30 September. Moving northeastward, it transformed into an extratropical cyclone east of Hokkaido Island at 12 UTC the next day. A peak gust of 61.2 m/s was recorded at Naha (47936), and a 24-hour precipitation total of 341.5 mm was recorded at Kumejima (47929). Two people were killed due to inundation and high waves in the prefectures of Mie and Okinawa. Damage to houses and farm products, power outages and transport disruption were also reported across a wide area of Japan.

(11) TY Prapiroon (1221)

Prapiroon was upgraded to tropical storm (TS) intensity southeast of Okinotorishima Island at 12 UTC on 7 October. Moving westward, it was upgraded to typhoon (TY) intensity at 18 UTC the next day. Prapiroon reached its peak intensity with maximum sustained winds of 90 kt and a central pressure of 940 hPa east of the Philippines at 12 UTC on 11 October. It then moved northeastward before turning southwestward on 15 October, and was downgraded to severe tropical storm (STS) intensity at 00 UTC the next day before turning northwestward. Keeping its STS intensity, Prapiroon accelerated northeastward on 17 October and transformed into an extratropical cyclone east of Japan at 12 UTC on 19 October. A peak gust of 34.9 m/s was recorded at Naha (47936). Cancellations of flights and ship departures were reported in Okinawa Prefecture.

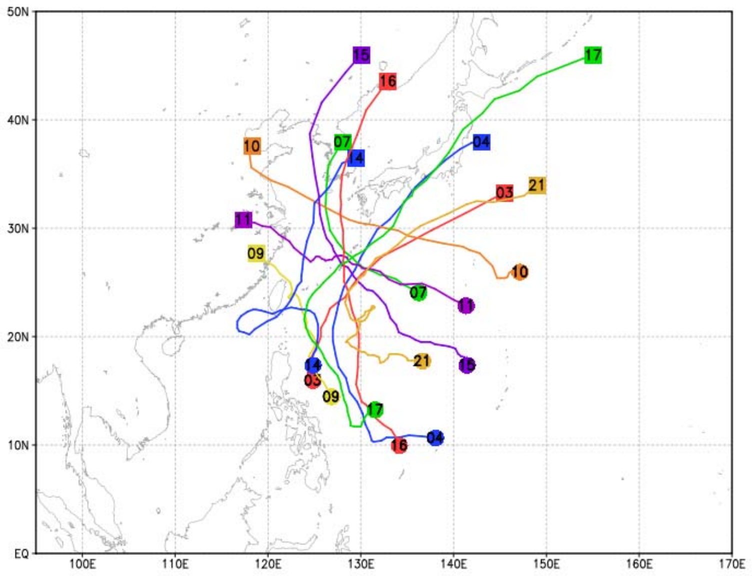

Fig.1 Tracks of the seven named TCs that affected Japan in 2012

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.

Fig. 2 Effects of TY Sanba (1216). Storm surge in Nagasaki Prefecture(photo: Shimabara City).

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

Typhoon Talas hit Japan’s Kii Peninsula in September 2012, creating 17 landslide dams caused by deep rapid landslides. Five of these were deemed to pose a high risk of overflowing or giving way and sending massive amounts of water and debris downstream. In response, Japan’s Ministry of Land, Infrastructure, Transport and Tourism (MLIT) conducted pumping to drain water and created temporary drainage channels using advanced construction technologies based on past experience of countermeasures against deep rapid landslides as urgent measures before the onset of the rainy season. The work was conducted in the face of many difficulties at the construction sites, including hazardous conditions relating to unstable debris, time constraints and limited accessibility.

Fig. 3 Nagatono landslide dam (height: approx. 80 m)

Fig. 4 Temporary drainage of Nagatono landslide dam

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

a-1. Provision of Storm Surge Time-series Charts for Typhoon Committee Members

JMA started providing storm surge time-series charts for the three locations of Macao, Quarry Bay (Hong Kong) and Hua Hin (Thailand) on 5 June, 2012. The charts are available on JMA's Numerical Typhoon Prediction website (https://tynwp-web.kishou.go.jp/) along with storm surge horizontal maps, which have been published since 1 June, 2011.

These charts are provided by JMA in response to requests from Typhoon Committee Members, and show predicted tides, astronomical tides and storm surges (i.e., the difference between predicted and astronomical tides). Astronomical tides are estimated with 60 tidal potential constituents determined from tidal observation data provided by Members, and the base water level is set at MSL (mean sea level) or CDL (chart datum level). For users' reference, surface pressure and surface wind data used in the storm surge model are also included in the charts.

JMA plans to add more locations upon request from Typhoon Committee Members. The addition of seven locations (one in Thailand and six in Korea) is scheduled for 2013, and further requests from Members are welcomed. This service is implemented within the framework of the WMO Storm Surge Watch Scheme (SSWS), and JMA started operating a storm surge model for the Asian region in 2011. An outline of the model is given in RSMC Tokyo - Typhoon Center Technical Review No. 14 (http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/techrev.htm).

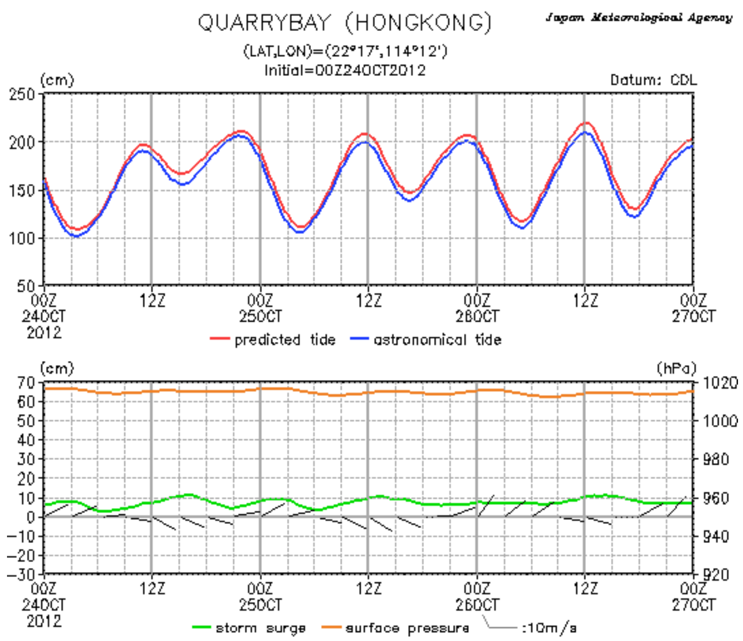

Fig.5 Example of a time-series chart (Quarry Bay, Hong Kong). The upper figure shows predicted (red line) and astronomical (blue line) tides. The zero level of the upper figure is

based on the CDL (chart datum level), and the green line in the lower figure depicts predicted storm surges. In the lower figure, surface pressure values (orange line) and wind barbs used in the storm surge model are also shown for reference.

(KRA 7)

b. Hydrological Achievements/Results

b-1. Flood Risk Reduction Using Satellite Information

The Southeast Asia Flood Risk Reduction Forum was held on February 20, 2012, in Bangkok, Thailand. The event was jointly organized by ESCAP (the Economic and Social Commission for Asia and the Pacific), ICHARM and JAXA (the Japan Aerospace Exploration Agency) to support the sharing of information on and lessons learned from the 2011 floods in Southeast Asia, including potential and actual applications for space-related and other technologies. The next few days were devoted to a workshop entitled Flood Risk Reduction Using Satellite Information.

(KRA2, 4, 5, 6, 7)

c. Disaster Prevention and Preparedness Achievements/Results

c-1. Major Disaster and Response Measures Implemented since January 2012

A high number of typhoons developed over the seas around Japan in 2012, with the three discussed below causing particularly heavy damage.

Typhoon No. 4 (Guchol) passed over Japan from June 18 to 20, bringing heavy rain to wide areas across the region from Okinawa to Tohoku in conjunction with the seasonal rain front and generating high waves and tides. Mudflows and landslides also occurred nationwide. In Shizuoka Prefecture, a man was crushed to death when a building collapsed. A total of 50 residences were damaged in Miyagi Prefecture, including 24 cases of inundation above floor level. In response, a meeting chaired by the minister of the Cabinet office responsible for disaster management was organized on June 19 by officials from national government ministries and agencies related to disaster management to discuss measures for damage mitigation. At the same time, it was decided that Japan should be designated as a potential area of intensified damage.

Typhoon No. 16 (Sanba) passed over the main island of Okinawa on September 16 before heading north toward the Saikai Sea and Kyushu on the 17th. As the typhoon approached, Okinawa/Amami and areas of western Japan were hit by torrential rain and gale-force winds. Sediment-related incidents such as mudflows, landslides and cliff collapses were observed in many areas. Tornados in the prefectures of Mie, Shizuoka and Ibaraki were reported on the 18th. Measures under the Disaster Relief Act and the Act on Support for Reconstructing Livelihoods of Disaster Victims were implemented for Kagoshima Prefecture’s Yoron-cho area, which sustained serious damage.

Typhoon No. 17 (Jelawat) passed over Okinawa/Amami on September 28 before touching down in Aichi Prefecture on the 30th and finally reaching the sea area east of Hokkaido, bringing heavy rain, gale-force winds, mudflows and landslides nationwide. The damage resulted in 1 fatality, 180 casualties and 2,751 residential inundations. Measures under the Act on Support for Reconstructing Livelihoods of Disaster Victims were implemented for Kagoshima Prefecture's Amagi-cho area, which sustained serious damage.

d. Research, Training, and Other Achievements/Results

e. Regional Cooperation Achievements/Results

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

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

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

<u>a-1. JMA's Climate Change Monitoring Report</u>

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).

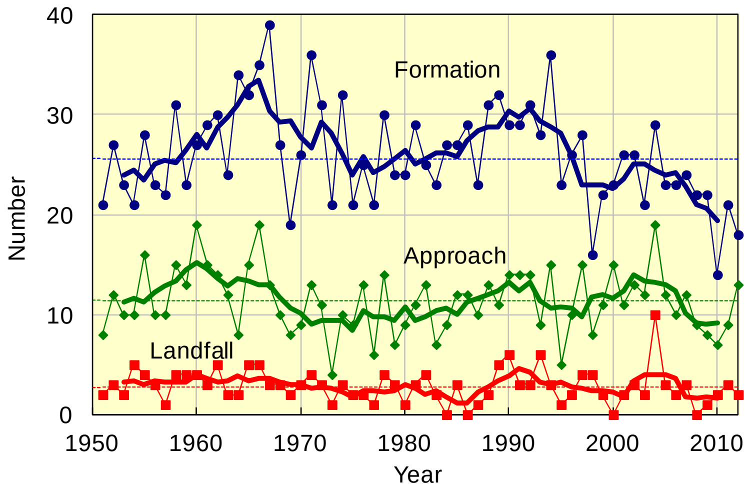

Fig.6 The number of tropical cyclones (TS intensity or higher) forming in the western North Pacific (top), those that approached Japan (middle) and those that hit Japan (bottom) as of 30 September, 2012. The thin, solid and dashed lines represent annual/five-year running means and normal values (1981 – 2010 averages), respectively.

(KRA1, 2, 5, 6)

b. Hydrological Achievements/Results

b-1. Flood Disaster Preparedness Indices (FDPI)

As part of the Annual Operating Plan (AOP) for the Working Group on Hydrology of the Typhoon Committee (WGH TC), the International Centre for Water Hazard and Risk Management (ICHARM) implemented activities related to Flood Disaster Preparedness Indices (FDPI) as described here.

1) FDPI Field Surveys in Thailand (December 6 – 14, 2011)

FDPI field surveys in Ubon Ratchathani Province and the Hat Yai district of Thailand were conducted in conjunction with the country's Department of Disaster Prevention and Mitigation (DDPM) and its offices in the provinces of Ubon Ratchathani and Songkla, the Mekong Sub-region Social Research Center (MSSRC) at Ubon Ratchathani University, and the Institute of Research and Development for Health of Southern Thailand (RDH) at Prince of Songkla University. In Ubon Ratchathani Province and the Hat Yai district, 11 community leaders or disaster management personnel from each area took part. The results were sent to the recipients through the counterparts.

2) FDPI Field Survey in Viet Nam (August 5 – 10, 2012)

An FDPI field survey was conducted in Hanoi City, Vietnam, in collaboration with Vietnam National University and the government of Hanoi. In the city, 13 community leaders or disaster management personnel in five districts (Tu Liem, Ba Vi, Thanh Tri, Hoang Mai and Thuong Tin) took part. The results were sent to the recipients through Vietnam National University.

A multi-language website is currently being developed to facilitate the implementation of FDPI surveys.

b-2. Publication of a Detailed Map Showing Susceptibility to Deep Rapid Landslides in Japan

MLIT's Sabo Department and the Public Works Research Institute (PWRI) published an assessed map of relative susceptibility to deep catastrophic landslides and a density map showing past deep catastrophic landslides in September 2012. The former indicates susceptibility to deep catastrophic landslides in each catchment basin which its size approximately 1 km2, especially in regard to areas of high risk indicated on the deep catastrophic landslide frequency map published in 2010. Evaluation of susceptibility to deep catastrophic landslides is based on past incidences, micro-topography and topography-related factors (e.g., slope gradient and catchment area). The density map shows concentrations of past deep catastrophic landslides in each catchment basin in the same way as the assessed map. Both maps mostly show high susceptibility and high concentrations for streams where deep catastrophic landslides occurred in relation to Typhoon Talas in 2011.

After Typhoon Talas, MLIT began installing a monitoring system to detect the occurrence of deep catastrophic landslides in high-frequency areas as indicated by the deep catastrophic landslide frequency map. The Ministry is also developing a methodology for use at model sites in its area of direct control over a period of three years to estimate the scale of potential deep catastrophic landslides and identify areas that may be affected.

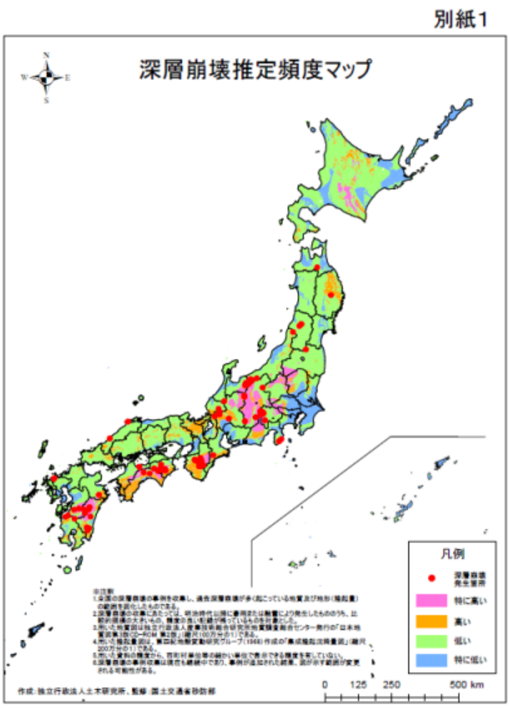

Fig.7 Deep catastrophic landslide frequency map (2010) (Pink shading indicates areas with an especially high frequency of deep catastrophic landslide occurrence.)

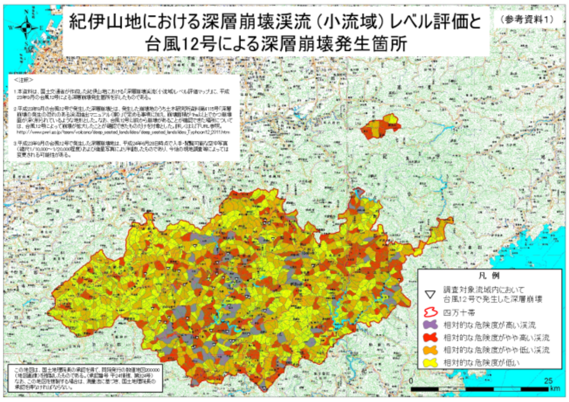

Fig.8 Assessed map showing susceptibility to deep catastrophic landslides on the Kii Peninsula(Grey: especially high susceptibility; red: high susceptibility; orange: low susceptibility; yellow: especially low susceptibility)

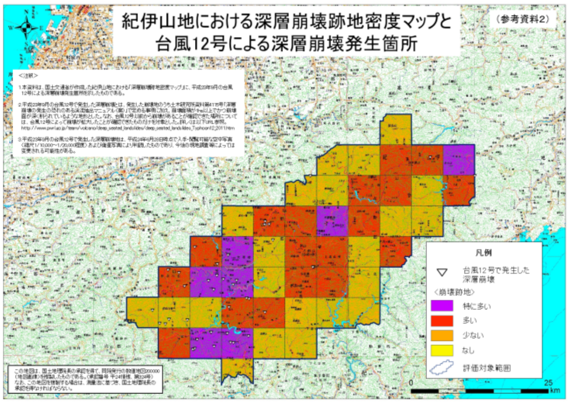

Fig.9 Density map showing past deep catastrophic landslides (Purple: especially high concentration; brown: high concentration; orange: low concentration; yellow: no record of past deep catastrophic landslides)

c. Disaster Prevention and Preparedness Achievements/Results

c-1. Visiting Researchers from ADRC Member Countries

The Asian Disaster Reduction Center (ADRC) has hosted visiting researchers (VRs) from member countries on a regular basis since 1999. To date, 67 officials have taken part in the program and benefited from Japan’s advanced knowledge and technology in the field of Disaster Risk Reduction (DRR). After finishing the program, VRs are expected to contribute to strengthening DRR capacity in their own countries and to further promote collaboration between their nations and the ADRC. In 2012, the Center hosted eight VRs as listed below.

FY	Name	Country
2012	Ms. Khangaldyan Armine	Armenia
	Mr. Liu Nanjiang	China
	Mr. Sekimov Adilet	Kyrgyz

	Mr. Moneer Abdullah Mohammed Al-Masni	Yemen
	Mr. Duni Chand Rana	India
	Mr. Agustian Rizal	Indonesia
	Ms. Ma Aletha Ahumada Nogra	Philippines
	Ms. Rujira Chariyaphan	Thailand

Fig.10 Visiting Researchers

d. Research, Training, and Other Achievements/Results

e. Regional Cooperation Achievements/Results

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

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

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. Upgrade plan for JMA’s global numerical weather prediction system

The supercomputer system at the Japan Meteorological Agency (JMA) was upgraded in June 2012, and is now in operation. The theoretical peak performance of the new Hitachi SR16000/M1 system (Figure 11) is about 30 times higher than that of its Hitachi SR11000 predecessor at more than 800 trillion floating-point operations per second.

Taking advantage of these advanced computational resources, JMA plans to upgrade its numerical weather prediction (NWP) system. The number of vertical levels in the operational Global Spectral Model (GSM) will be enhanced from 60 (L60) to 100 (L100), and the top level of the model will be raised from 0.1 hPa to 0.01 hPa. This higher vertical resolution is expected to improve the representation of atmospheric vertical structure and atmospheric processes; this applies particularly to those in the boundary layer, which is quite important in tropical cyclone (TC) forecasting with numerical weather prediction models. Raising the model's top level enables better usage of satellite data channels, which are sensitive to middle atmosphere conditions, in data assimilation.

JMA also plans to upgrade its Typhoon Ensemble Prediction System, which is run up to four times a day with a forecast range of 132 hours and specializes in TC forecasting. The upgrade includes enhancement of the spatial resolution and the number of vertical levels in the forecast model from TL319L60 to TL479L100 and an increase in the ensemble size from 11 to 25. The enhancement of the model's horizontal resolution will lead to better representation of TC structures and high-impact weather conditions such as heavy precipitation and strong wind accompanying TCs. The aim of increasing the ensemble size is to improve the reliability of TC strike probability forecasts. Preliminary results show a positive impact from the size increase on probabilistic TC track forecasts, as shown in Figure 11.

Fig. 11 JMA's new supercomputer system

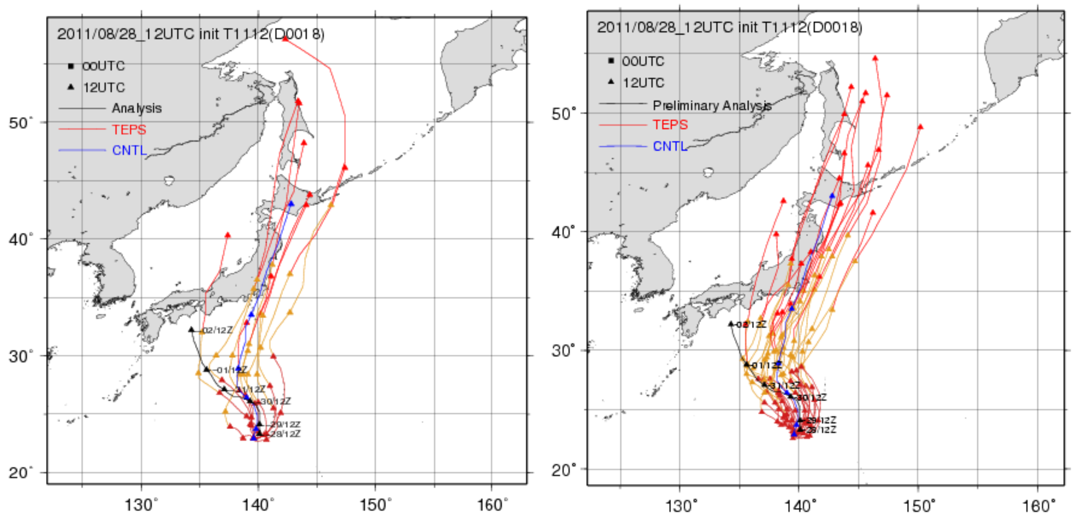

Fig.12 Ensemble TC tracks of Typhoon T1112 (Talas) covering periods up to 120 hours derived from the operational Typhoon EPS (11 members, left panel) and an experimental EPS (25 members, right panel). The initial time is 12 UTC on 28 August, 2011. Black and colored lines indicate the best track and forecast tracks, respectively.

a-2. Update plan for the global NWP data assimilation system

JMA continues to develop the global NWP data assimilation (DA) system toward better initial condition analysis, which is expected to lead to better NWP forecasting of tropical cyclones. As part of these efforts, the Agency plans to apply the following improvements in the near future: (1) upgrade of the radiative transfer model for satellite radiance data assimilation; (2) upgrade of global navigation satellite system (GNSS) radio occultation (RO) data usage.

(1) The RTTOV 9.3 radiative transfer model currently used in the DA system as an observation operator for satellite radiance data assimilation is scheduled for upgrade to RTTOV 10. The package includes a land surface emissivity database and enables effective use of microwave humidity sounder (MHS) data from over land areas with the DA system. It provides more homogeneous and accurate humidity analysis for areas over land.

(2) GNSS RO refractivity data are currently assimilated with a bias correction scheme. However, it was found that the observation operator should be revised in conversion algorithms of vertical interpolation of geopotential height, and preliminary study with the upgraded observation operator showed that bias correction procedures were not needed and that GNSS RO data has a large impact on the skill of the global NWP model.

(KRA1, 2, 4, 5, 7)

a-3. Weekly report on extreme climate events

JMA issues 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/).

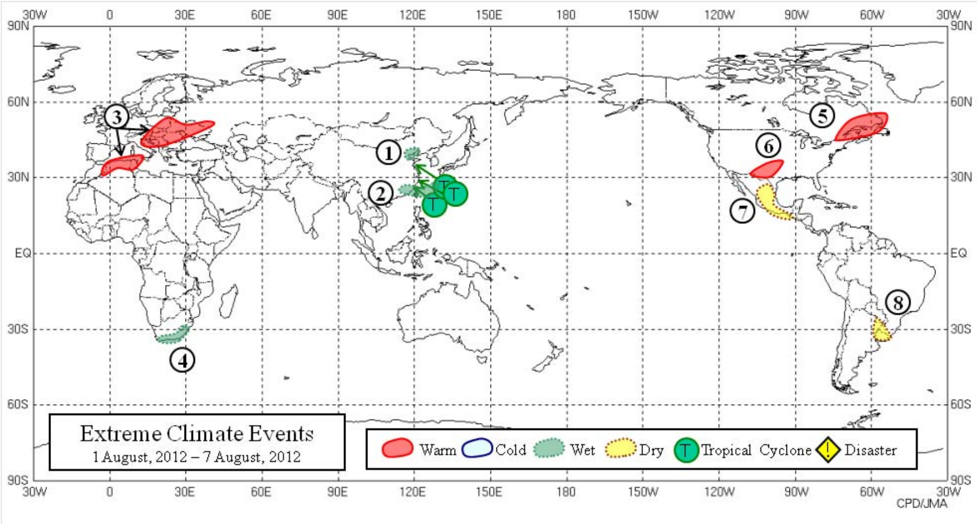

Fig.13 Distribution of global extreme climate events (1 – 7 August, 2012). The figure highlights areas where extreme climate events were identified from SYNOP messages, and also shows the tracks of tropical cyclones based on preliminary data from tropical cyclone centers worldwide.

(KRA 1, 2, 4, 5, 7)

b. Hydrological Achievements/Results

c. Disaster Prevention and Preparedness Achievements/Results

d. Research, Training, and Other Achievements/Results

d-1. Tropical cyclone track forecasts using a JMA model with ECMWF and JMA initial conditions

JMA's Global Spectral Model (JMA/GSM) was run from the initial conditions of the European Centre for Medium-Range Weather Forecasts (ECMWF), which are available in the Year of Tropical Convection (YOTC) data set, to distinguish between TC track prediction errors attributable to initial conditions and those attributable to the numerical weather prediction (NWP) model. The average position error was reduced by about 10% by replacing the initial conditions, and predictions in some cases were significantly improved. In these cases, the low wavenumber component of the ECMWF analysis was found to account for most of the improvement. In addition, the observed tracks were captured by JMA's Typhoon Ensemble Prediction System (TEPS), which deals with initial condition uncertainties. In some cases, however, replacement of the initial conditions did not improve prediction even when the ECMWF forecast was accurate. In these cases, TEPS was also unable to capture the observed track, implying the need to address uncertainties associated with the NWP model.

d-2. Use of TIGGE data to evaluate tropical cyclone genesis prediction in the western North Pacific

A World Weather Research Programme-Research Development Project (WWRP-RDP) called the North Western Pacific Tropical Cyclone (TC) Ensemble Forecast Project (NWP-TCEFP) was launched as a five-year initiative in 2009, and JMA's Meteorological Research Institute (MRI/JMA) developed a website on which ensemble products created using TIGGE CXML are available (http://tparc.mri-jma.go.jp/cyclone/login.php). These products are widely used by Typhoon Committee Members and forecasters involved with the Severe Weather Forecasting Demonstration Project (SWFDP) in Southeast Asia.

MRI/JMA set out to investigate tropical cyclogenesis events in the western North Pacific basin using TIGGE data under the RDP. A vortex-tracking algorithm developed by Dr. Frederic Vitart of ECMWF (Vitart et al., 1997) was used in this study. The vortex tracker locates the positions of intense vortices with warm core structures to support the elimination of extratropical storms. The initial results show that the number of vortices detected differs significantly among numerical weather prediction centers (Fig. 14) and is also sensitive to the algorithm's parameters, such as the threshold values of vorticity at 850 hPa and the presence of a warm core.

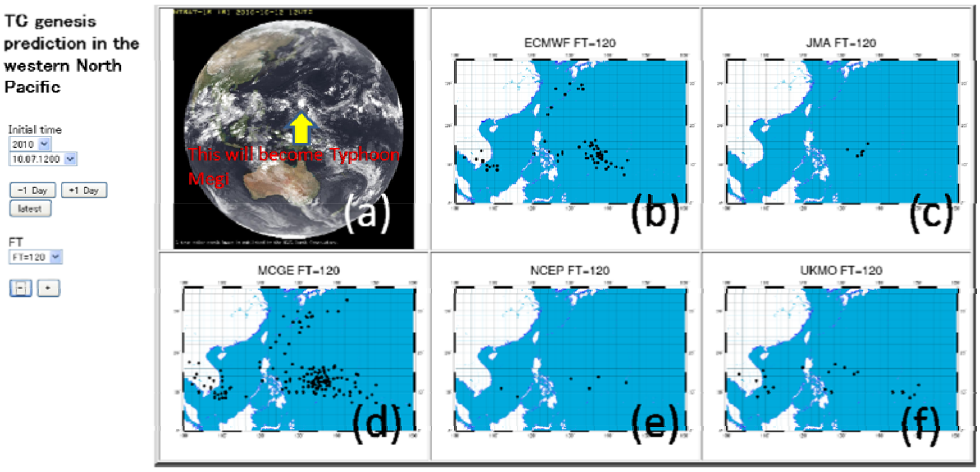

Fig.14 Each black dot in (b), (c), (e) and (f) represents a tropical storm detected using the vortex tracker by ECMWF, JMA, NCEP and UKMO EPS, respectively. (d) shows a combination of the four EPSs, or the multi-center grand ensemble (MCGE). This is a five-day prediction initiated at 1200 UTC on 7 Oct., 2010. The time here is 1200 UTC on 12 Oct., 2010, 12 hours prior to the genesis of Typhoon Megi. (a) shows an IR image taken at this time.

d-3. Relationship of maximum tropical cyclone intensity to sea surface temperature and tropical cyclone heat potential in the North Pacific Ocean

Whether or not the maximum intensity of tropical cyclones (TCs) in the North Pacific Ocean depends on sea surface temperature (SST) and tropical cyclone heat potential (TCHP) was investigated using reanalysis datasets for both the oceans and atmosphere: daily, 10-day, and monthly oceanic datasets; six-hour and monthly atmospheric datasets; and a daily satellite SST dataset, for the July-to-October season from 2002 to 2005. For each TC, we summed TCHP from the time of genesis to the time of first reaching a minimum central pressure (MCP), to obtain an accumulated TCHP. In a linear regression analysis, the relationship between maximum TC intensity and accumulated TCHP differed between the eastern and western Pacific: high values of accumulated TCHP were needed before a TC attained a certain MCP in the western Pacific. In addition, the background convective available potential energy (CAPE) value was nearly four times larger in the western Pacific than in the eastern Pacific. The static stability was also 6.5% lower, the inertial stability 29.7% higher, and the size of tropical cyclones 38.2% larger in the western Pacific than in the eastern Pacific. The result indicated a deeper Rossby penetration depth and a stronger TC in the western Pacific. Finally, the TCHP values derived from three oceanic reanalysis datasets were validated by using Argo profiling float observations. Use of only the daily data can reproduce the cooling effect of a passage of a TC, which caused a decrease in the TCHP values.

d-4. Development of an estimation method for TC central pressure using Advanced Microwave Sounding Unit (AMSU) observation

To improve estimation of tropical cyclone (TC) central pressure, a new algorithm has been developed at MRI using brightness temperature (Tb) data obtained from observations made by Advanced Microwave Sounding Units (AMSUs) on board polar orbiting satellites. Upper-tropospheric warm-core intensity was calculated based on the Tb anomaly maximum near the TC center as derived from AMSU-A channels 6, 7 and 8 for 365 observation cases in 2008, and the outcome was related to TC central pressure in JMA's best-track data via a one-dimensional regression equation. The accuracy of the estimates obtained from this equation was improved by correcting Tb errors caused by the properties of the AMSU, i.e., its large footprint, its variation in relation to the scan position, and Tb attenuation caused by ice water particles.

Using the algorithm developed, estimation was performed for 1,015 observation cases from 2009 to 2011 and the results were compared with JMA's best-track data. Annual statistics showed estimation errors of 8.5 – 11.8 hPa in RMSE and -0.5 – 2.7 hPa in bias. In particular, the characteristics of several rapidly intensifying TCs including TY Meari (1105) were skillfully estimated in comparison with the results of JMA's operational analysis. In other cases, however, intensity was still underestimated, partly because of the small warm cores of TCs. Although there is still room for further improvement, this algorithm was provided to JMA's RSMC Tokyo - Typhoon Center in December 2011 for testing and validation.

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

a-1. TCC News

Tokyo Climate Centre (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 services. The latest issue, TCC News No. 30, covers the near-normal frequency seen in the formation of tropical cyclones of tropical storm (TS) intensity or higher over the western North Pacific in 2012, and discusses two typhoons that caused fatalities in China, the Philippines and Viet Nam (http://ds.data.jma.go.jp/tcc/tcc/news/tccnews30.pdf)..

(KRA1, 2, 4, 5）

b. Hydrological Achievements/Results

b-1. Flooding in Thailand

Flooding over the Chao Phraya River basin in Thailand caused severe damage to agriculture, industry and urban life across large parts of the basin in mid-October 2011. In response to the disaster, JICA implemented a new initiative called the Project on a Comprehensive Flood Management Plan for the Chao Phraya River Basin to support the Thai Government. ICHARM is involved in the project as a supporting member of JICA, and hopes to contribute to Thailand's future flood risk management capacity by providing technical assistance. ICHARM also launched a research project titled A Study on the Chain Reaction Impact of the 2011 Chao Phraya River Floods on the Global Economy in April 2012 to clarify the worldwide impact of economic damage sustained in Thailand from the flooding.

(KRA1, 2, 4, 6)

c. Disaster Prevention and Preparedness Achievements/Results

c-1. Urban Search-and-rescue Training in Singapore as an ADRC Activity for Disaster Mitigation

The Singaporean Government holds a training course every year for search-and-rescue officers. The course has hosted trainees from outside Singapore for the past 10 years and provides training on the search-and-rescue expertise required in urban disaster situations. The training facility complex of the Civil Defense Academy (CDA) run by the Singapore Civil Defense Force (SCDF) is one of the highest-level facilities of its kind in Asia. To optimally utilize its expertise and facilities, the ADRC has regularly invited relevant officers from member countries to attend the training course since 2001. Two officers from Bangladesh and Russia participated in 2011, and two from Mongolia and Thailand attended from September 24 to October 5, 2012.

Fig.15 Urban search-and-rescue training in Singapore

d. Research, Training, and Other Achievements/Results

d-1. 12th Typhoon Committee Attachment Training at the RSMC Tokyo - Typhoon Center

JMA's RSMC Tokyo - Typhoon Center provides assistance to members of the ESCAP/WMO Typhoon Committee in typhoon analysis and forecasting services. One of the Center's activities involves holding on-the-job training on typhoon operations for forecasters in the region to improve analysis and forecasting skills through the exchange of views and the sharing of experience in the field. Two forecasters – Mr. Ngo Hai Duong (from Viet Nam) and Ms. Connie Rose S. Dadivas (from the Philippines) – visited JMA's Headquarters from 18 to 27 July, 2012, to participate in the 12th Typhoon Committee Attachment Training. The information covered included the following areas:

1. The Satellite Analysis and Viewer Program (SATAID)
2. Tropical cyclone analysis (Dvorak technique)
3. Tropical cyclone forecasting
4. Storm surges
5. Quantitative precipitation estimation (QPE) and quantitative precipitation forecasting (QPF)
6. The Severe Weather Forecasting Demonstration Project (SWFDP)

Fig.16 Participants on a courtesy visit to JMA Director-General Dr. Mitsuhiko Hatori. Dr. Hatori is shown between Mr. Ngo Hai Duong (right) and Ms. Connie Rose S. Dadivas (left) with National Typhoon Center staff (18 July, 2012, Director-General's office).

During the training, two tropical storm landfalls (Severe Tropical Storm Khanun on the Korean Peninsula and Typhoon Vicente on South China) were observed. This allowed the two trainees to gain hands-on experience of TC analysis and forecasting using real-time examples.

Fig.17 Discussion in the operation room (JMA's Forecast Division) (left). Lecture and training in JMA’s seminar room (right).

(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 11 September to 7 December 2012. 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 Lao PDR from among the TC members) acquired skills in the utilization of satellite data including tropical-cyclone analysis, and learned about the application of numerical weather prediction products and radar data. The course also included technical tours to research institutes, private weather companies, airlines, meteorological instrument manufacturers, 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. *Collaboration for the Mekong Region and the Philippines*

The Mekong River Commission Secretariat, the Cambodian National Mekong Committee, the Asian Development Bank (ADB) and the International Centre for Water Hazard and Risk Management (ICHARM) held a workshop on flood vulnerability in Cambodia from February 9 to 10, 2012 in Phnom Penh. The objectives of the workshop were to share information on (i) the Mekong river flood of 2010 and the present status, (ii) definitions of vulnerability and other technical concepts, and (iii) a flood vulnerability assessment method. ICHARM’s hydro-geo method was developed to assess potential agricultural and household damage (i.e., vulnerability) using existing satellite topography information, hydrological data and social survey data from

Cambodian flood plains.

The Philippine Atmospheric, Geophysical & Astronomical Services Administration, the ADB and ICHARM also co-hosted a capacity development training program for flood risk management from September 26 to 28 in Metro Manila and from October 2 to 4 in Tuguegarao City, attracting a total of 63 administrators and practitioners from different agencies involved in flood risk management in the Pampanga and Cagayan River basins. In the Philippines, where serious floods occur every year, flood forecast technology is expected to help mitigate potential related damage. In particular, the introduction of remote sensing technologies such as the Integrated Flood Analysis System (IFAS), which supports the implementation of flood forecasting/warning systems in poorly gauged river basins, is keenly expected to provide useful supplementary information. These activities are implemented within the framework of the ADB Technical Assistance for Supporting Investment in Water-related Disaster Risk Management initiative (TA 7276).

e. Regional Cooperation Achievements/Results

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

- Two JMA experts visited Vietnam to give lectures on NWP techniques and Typhoon Analysis in June 2012.
- Two JMA experts visited Vietnam to give lectures on Interactive Tool for Analysis of the Climate System (ITACS) for climate services in March 2012.
- Two JMA experts visited Lao P.D.R to give lectures on satellite analysis on typhoon using SATAID and ITACS for climate services in March 2012.
- Two JMA experts will visit Hong Kong Observatory to provide lectures on NHM models and data assimilation in December 2012.

e-2. Technical visits to JMA

- Two delegations from the China Meteorological Administration visited JMA for technical exchange on emergency response in April and May 2012.
- An expert from the Hong Kong Observatory visited JMA to learn JMA's NHM model in January 2012.
- Two experts from Thailand Meteorological Department visited JMA for technical training on radar composite maps as part of the activities of the project *Development of Regional Radar Network* endorsed during the 44th TC session in November 2012.

f. Identified Opportunities/Challenges for Future Achievements/Results

III. Resource Mobilization Activities

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