MEMBER REPORT

ESCAP/WMO Typhoon Committee
8th Integrated Workshop/2nd TRCG Forum

Japan

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CONTENTS

I. Overview of tropical cyclones which have affected/impacted Member's area in 2013 (Free format)

1. Meteorological Assessment (highlighting forecasting issues/impacts)

In 2013, 14 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 13 of these, with 2 making landfall. These 13 TCs are described below, and their tracks are shown in Figure 1.

(1) TS Leepi (1304)

Leepi was upgraded to TS intensity east of the Philippines at 00 UTC on 18 June. Moving northward, it reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 994 hPa 18 hours later.

Leepi passed near Miyakojima Island the next day and transformed into an extratropical cyclone over the East China Sea at 00 UTC on 21 June, and a 24-hour precipitation total of 222.0 mm was recorded at Ishigakijima (47918). Damage to houses and cancellations of flights and ship departures were reported in Okinawa Prefecture.

(2) TY Soulik (1307)

Soulik was upgraded to TS intensity around the Mariana Islands at 00 UTC on 8 July, and was further upgraded to TY intensity west of the islands at 00 UTC the next day. Turning west-northwestward, it developed rapidly and reached its peak intensity with maximum sustained winds of 100 kt and a central pressure of 925 hPa north of Okinotorishima Island at 00 UTC on 10 July. Keeping its west-northwestward track and TY intensity, Soulik hit Taiwan Island late on 12 July. It crossed the Taiwan Strait and hit China with STS intensity the next day. Turning northward, it weakened to tropical depression (TD) intensity at 00 UTC on 14 July.

A peak gust of 60.2 m/s was recorded at Yonagunijima (47912). Damage to houses and farm products, power outages and transport disruption were reported in Okinawa Prefecture.

(3) STS Trami (1312)

Trami was upgraded to TS intensity south of Okinawa Island at 00 UTC on 18 August. It turned northward the next day and then northwestward the day after that before reaching its peak intensity with maximum sustained winds of 60 kt and a central pressure of 965 hPa near Miyakojima Island at 21 UTC on 20 August. After moving westward over the East China Sea, it hit China with STS intensity late the next day and then weakened to TD intensity over China at 18 UTC on 22 August.

Cancellations of flights and ship departures were reported in Okinawa Prefecture.

(4) STS Kong-rey (1315)

Kong-rey was upgraded to TS intensity east of Luzon Island at 06 UTC on 26 August. Keeping its northward track, it reached its peak intensity with maximum sustained winds of 55 kt and a central pressure of 980 hPa east of Taiwan Island at 12 UTC on 28 August. After entering the East China Sea, Kong-rey was downgraded to TS intensity at 00 UTC on 29 August and then turned northeastward. It weakened to TD intensity at 00 UTC the next day.

A peak gust of 33.3 m/s was recorded at Yonagunijima (47912). Cancellations of ship departures were reported in Okinawa Prefecture.

(5) STS Traji (1317)

Traji was upgraded to TS intensity north of the Sakishima Islands at 18 UTC on 1 September. Keeping its northeastward track, it was upgraded to severe tropical storm (STS) intensity and reached its peak intensity with maximum sustained winds of 50 kt and a central pressure of 985 hPa west of the Amami Islands at 00 UTC on 3 September. Traji made landfall around Ibusuki City in Kagoshima Prefecture with STS intensity around 18 UTC that day and transformed into an extratropical cyclone over the southwestern part of Shikoku Island six hours later.

A peak gust of 35.8 m/s was recorded at Unzendake (47818), and a 24-hour precipitation total of 235.0 mm was recorded at Shimizu (47898). Inundation caused two fatalities, and damage to houses and farm products, power outages and transport disruption were also reported across a wide area stretching from Okinawa to Kanto.

(6) TY Man-yi (1318)

Man-yi was upgraded to TS intensity south of the Ogasawara Islands at 00 UTC on 13 September. After turning north-northeastward, it was upgraded to TY intensity and reached its peak intensity with maximum sustained winds of 65 kt and a central pressure of 960 hPa south of Shikoku Island at 12 UTC on 15 September. Man-yi made landfall around Toyohashi City in Aichi Prefecture with STS intensity before 23 UTC the same day. Keeping its northeastward track, it transformed into an extratropical cyclone southeast of Hokkaido Island at 12 UTC on 16 September.

A peak gust of 38.3 m/s was recorded at Kobe (47770), and a 24-hour precipitation total of 378.5 mm was recorded at Owase (47663). Landslides and strong winds caused six fatalities, and damage to houses and farm products, power outages and transport disruption were also reported across a wide area stretching from Shikoku to Hokkaido.

(7) STS Pabuk (1320)

Pabuk was upgraded to TS intensity around the Mariana Islands at 06 UTC on 21 September. Moving northwestward, it was upgraded to STS intensity south of the Ogasawara Islands at 06 UTC the next day and reached its peak intensity with maximum sustained winds of 60 kt and a central pressure of 965 hPa west of the islands at 12 UTC on 24 September. Pabuk turned northeastward the next day and transformed into an extratropical cyclone east of Japan at 00 UTC on 27 September. Cancellations of ship departures were reported in Tokyo Prefecture.

(8) TS Sepat (1322)

Sepat was upgraded to TS intensity east of the Ogasawara Islands at 00 UTC on 30 September. Gradually turning northward, it reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 992 hPa off the eastern coast of Honshu Island at 06 UTC on 2 October. After turning northeastward, Sepat transformed into an extratropical cyclone east of Japan at 18 UTC the same day. Cancellations of flights and ship departures were reported in Tokyo Prefecture.

(9) TY Fitow (1323)

Fitow was upgraded to TS intensity east of the Philippines at 12 UTC on 30 September. Moving northward, it was upgraded to TY intensity south of Okinawa Island at 12 UTC on 4 October. Fitow reached its peak intensity with maximum sustained winds of 75 kt and a central pressure of 960 hPa east of Miyakojima Island at 06 UTC the next day. It moved over the East China Sea and hit China with STS intensity late on 6 October. Fitow weakened to TD intensity at 06 UTC the next day.

A peak gust of 37.0 m/s was recorded at Miyakojima (47927). Damage to houses and farm products, power outages and transport disruption were reported in Okinawa Prefecture.

(10) TY Danas (1324)

Danas was upgraded to TS intensity around the Mariana Islands at 06 UTC on 4 October. Moving northwestward, it was upgraded to TY intensity east of Okinotorishima Island at 18 UTC the next day. Danas reached its peak intensity with maximum sustained winds of 100 kt and a central pressure of 935 hPa southwest of Minamidaitojima Island at 00 UTC on 7 October. After passing near Yoronjima Island that day, it gradually turned northeastward over the East China Sea. Danas passed around Tsushima Island with STS intensity around 12 UTC on 8 October and moved over the Sea of Japan. Keeping its northeastward track, it transformed into an extratropical cyclone at 00 UTC the next day. A peak gust of 48.9 m/s was recorded at Okinoerabujima (47942). Damage to houses and farm products, power outages and transport disruption were reported across a wide area stretching from Okinawa to Tohoku.

(11) TY Wipha (1326)

Wipha was upgraded to TS intensity west of the Mariana Islands at 18 UTC on 10 October. Moving northwestward, it was upgraded to TY intensity southeast of Okinotorishima Island at 12 UTC on 12 October. Wipha reached its peak intensity with maximum sustained winds of 90 kt and a central pressure of 930 hPa north of the island at 00 UTC on 14 October. Accelerating northeastward the next day, it passed around the Izu Islands with TY intensity and transformed into an extratropical cyclone at 06 UTC on 16 October.

A peak gust of 46.1 m/s was recorded at Choshi (47648), and a 24-hour precipitation total of 321.5 mm was recorded at Tateyama (47672). Landslides caused 34 fatalities and strong winds caused 3. Damage to houses and farm products, power outages and transport disruption were also reported across a wide area of Japan.

(12) TY Francisco (1327)

Francisco was upgraded to TS intensity southwest of the Mariana Islands at 12 UTC on 16 October. Moving northward, it was upgraded to TY intensity over the same waters at 06 UTC the next day. Francisco rapidly developed and reached its peak intensity with maximum sustained winds of 105 kt and a central pressure of 920 hPa west of the islands at 18 UTC on 18 October. Moving northwestward, it gradually weakened and turned northeastward over the sea east of Okinawa Island on 24 October. Accelerating northeastward, Francisco transformed into an extratropical cyclone east of Japan at 06 UTC on 26 October.

A peak gust of 38.9 m/s was recorded at Minamidaitojima (47945), and a 24-hour precipitation total of 309.5 mm was recorded at Owase (47663). Damage to houses and farm products, power outages and transport disruption were reported across a wide area stretching from Okinawa to Kanto.

(13) TY Lekima (1328)

Lekima was upgraded to TS intensity west of the Marshall Islands at 18 UTC on 20 October. Moving northwestward, it was upgraded to TY intensity northwest of the islands at 03 UTC on 22 October. Lekima rapidly developed and reached its peak intensity with maximum sustained winds of 115 kt and a central pressure of 905 hPa east of the Mariana Islands at 00 UTC the next day. It accelerated northeastward over the sea east of the Ogasawara Islands on 25 October. Lekima transformed into an extratropical cyclone east of Japan at 12 UTC the next day.

Cancellations of ship departures were reported in Tokyo Prefecture.

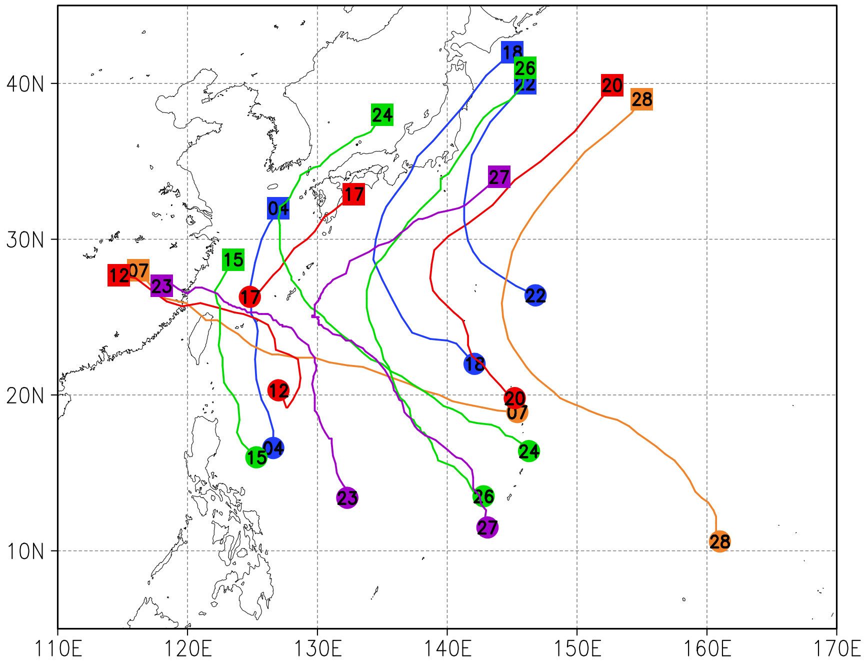

Figure 1　Tracks of the 13 named TCs affecting Japan in 2013
The numbered circles represent the genesis point of each named TC, while the squares show the dissipation point. The numbers indicate the last two digits of the identification number for each named TC.

Figure 2　Impacts of T1326 on Izu Oshima Island
Left: massive landslides; right: landslide debris (photos: JMA)

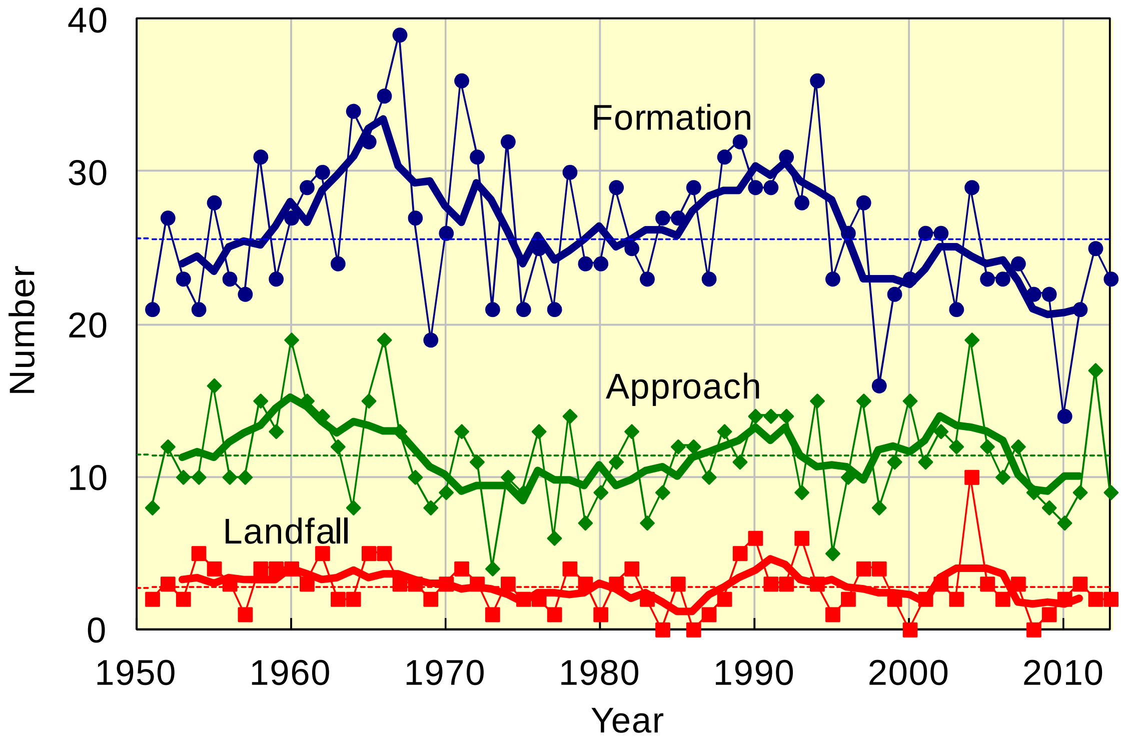

Figure 3 Tropical cyclones (TS intensity or higher) forming over the western North Pacific (top), those approaching Japan (middle) and those making landfall on Japan (bottom) as of 30 September, 2013. The thin, solid and dashed lines represent annual/five-year running means and normal values (1981 – 2010 averages), respectively. 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 and to NMHSs via the Tokyo Climate Center's website (http://ds.data.jma.go.jp/gmd/tcc/tcc/products/gwp/gwp.html).

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

TY Man-yi (1318)

As Typhoon Man-yi approached and passed over Japan, heavy rainfall was observed over a wide area of the country from Shikoku in the south to Hokkaido in the north. The total rainfall from September 15 to 16 exceeded 400 mm in the Kinki and Tokai regions, with record 24-hour rainfall totals reported at 35 gauging points. In particular, emergency warnings were issued in the prefectures of Kyoto, Shiga and Fukui for the first time since the warning category was introduced. The heavy rainfall caused disaster conditions including landslides and flooding, leaving six people dead, one missing and over 10,000 houses flooded from Shikoku to Hokkaido.

However, flood control projects nationwide proved effective in reducing the impact of the heavy rainfall, with regional dams operating as intended to regulate floodwater.

Damage caused by Typhoon No. 18	
Fatalities	6
People missing	1
Houses flooded above floor level	3,011
Houses flooded below floor level	7,078

A record-high water level was reported in the Yuragawa River (based on data from the Fukuchiyama gauging station), exceeding that recorded when Typhoon Chaba (0416) hit Japan in 2004 and causing serious damage in the lower Yuragawa River basin. This extreme flooding led to extraordinary inundation damage over the entire basin, with the water level, the inundation area and the number of flooded houses all reaching historical highs. Evacuation orders were issued to 38,204 households (87,496 people) in Fukuchiyama and Ayabe, and evacuation advisories were issued to 48,851 households (107,677 people) in Maizuru and other areas.

At the Tenryuji water-level gauging station on the Katsuragawa River (a tributary of the Yodogawa River system), the previous high water level was exceeded by about 80 cm. A total of 93 Arashiyama households were flooded as well as popular tourist spots in the vicinity. Floodwater flowed along the Keihan Dentetsu Railway line, poured into the Kyoto City subway and flooded Goryo Station. The flooding seriously affected the local traffic network and prompted a four-day suspension of operations on the municipal subway, causing about 300 million yen worth of damage to the city. The heavy rainfall brought by Typhoon Man-yi caused large-scale flooding in the Katsuragawa River and the highest inflow recorded in the history of the Hiyoshi Dam, which played a major role in flood regulation by reducing the downstream discharge as much as 90%.

Fig.4 Serious flooding in Kyoto prefecture (photos: MLIT Kinki)
Yuragawa River, Fukuchiyama City (left)
Katsuragawa River, Kyoto City (right)

TY Wipha (1326)

In October 2013, Typhoon Wipha (1326) brought approximately 800 mm of precipitation and devastating damage to Tokyo's Izu Oshima Island, with 35 fatalities and 6 people missing (as of Nov. 5) as a result of debris flow. Izu Oshima is a volcanic island, and the typhoon triggered debris flows and slope failures simultaneously in the thin volcanic ash layer of hillside surfaces there.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) immediately dispatched its Technical Emergency Control Force (TEC-FORCE) to the island to evaluate the extent of the damage and prevent secondary disasters. TEC-FORCE set up a video monitoring system to observe streams affected by debris flow and performed emergency ground surveying at all local streams and slopes considered to be at risk of further damage to clarify the possibility of secondary disasters before the approaching Typhoon Francisco (1327) arrived. The group also provided monitoring system information and the results of the emergency ground surveying to the local prefectural government and municipal office in order to support decisions relating to resident safety.

Fig.5 Devastating debris flows on Izu Oshima Island

Fig.6 TEC-FORCE activities
Monitoring of a stream affected by debris flow (left),
emergency ground surveying (right)

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

In 2013, 31 typhoons had formed over the western North Pacific and the South China Sea as of 14 November. Half of these approached the Japanese islands, and three made landfall (Nos. 17, 18 and 26). The latter of these caused serious damage to Tokyo's Oshima Town.

STS Traji (1317)

Toraji hit Kagoshima Prefecture on 4 September, bringing heavy rain across a wide area together with STS Kong-rey (1315) and a coinciding front. The rain caused two fatalities and affected 2,100 houses (including 1,800 that were flooded below floor level) in Aichi Prefecture.

A number of F0 and F1 tornados also formed in certain areas due to atmospheric instability associated with the typhoon's landfall. Although these caused no fatalities, more than 60 people were injured and 1,500 houses were damaged.

For tornado-affected districts, the Government of Japan applied the Disaster Relief Act and the Act on Support for Livelihood Recovery of Disaster Victims.

TY Man-yi (1318)

Man-yi hit Aichi Prefecture on 16 September, causing heavy rain across a wide area stretching from Shikoku to Hokkaido. This resulted in six fatalities, left one person missing, and damaged over 11,000 houses.

F0 and F1 tornados also formed in certain areas in association with the typhoon. Although these caused no fatalities, ten people were injured and over 900 buildings were damaged.

In response, the Government of Japan held meetings with relevant ministries/agencies and dispatched government investigation teams headed by the Parliamentary Secretary for Disaster Management to the affected areas. It also designated the typhoon as an Extremely Severe Disaster to support early recovery of the affected areas and allow the allocation of additional subsidies for recovery projects. The government further applied the Disaster Relief Act and the Act on Support for Livelihood Recovery of Disaster Victims, and dispatched Japan Self-Defense Forces to search for and rescue missing/isolated people.

TY Wipha (1326)

Although Wipha did not make landfall, it caused heavy rain in Tokyo's Oshima Town, where hourly rainfall of 100 mm and a 24-hour total of 824 mm were recorded. The rain caused landslides, resulting in 41 fatalities and leaving nine people missing. A total of 6,365 houses were also damaged in the prefectures of Chiba, Saitama and elsewhere.

In response, the Government of Japan swiftly established a Government Local Disaster Response Office in Oshima Town to support resident evacuation and prevent secondary disasters. It also designated the typhoon as an Extremely Severe Disaster and applied the Disaster Relief Act and the Act on Support for Livelihood Recovery of Disaster Victims to the affected districts, and dispatched Japan Self-Defense Forces to search for and rescue missing people.

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

II. Summary of progress in Key Result Areas

TC Members' Report
Summary of Progress in KRAs

Asian Conference on Disaster Reduction (ACDR) 2013

Information sharing among ADRC member countries, advisor countries and other relevant organizations is indispensable for strengthening the network of people working on disaster risk reduction in Asia. The Asian Disaster Reduction Center (ADRC) holds an annual international conference attended by disaster risk management officials from member countries and disaster experts from international organizations to promote information sharing, discussions and partnerships among participating countries and organizations.

The Asian Conference on Disaster Reduction (ACDR) 2013 held in Kobe, Japan, on 23 January, 2013, was organized jointly by the Government of Japan, the United Nations Secretariat of the International Strategy for Disaster Reduction (UNISDR) and ADRC. A total of 83 people attended, including high-level government officials from 25 countries and representatives from 15 international and regional organizations, the academic community and the private sector.

The key topics addressed at ACDR 2013 were as follows:

1. Space-based Technologies for DRR
2. Engagement of the Private Sector in DRR
3. Global Trends in DRR Toward a Post-HFA World

ACDR 2013 attendees

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.)

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							✓
Training and research							✓
Resource mobilization or regional collaboration							✓

Member: Japan

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TC Members' Report
Summary of Progress in KRAs

Urban search-and-rescue training in Singapore as an ADRC activity for disaster reduction

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 ten years for training on the search-and-rescue expertise required in urban disaster situations. It is held at the training facility complex of the Civil Defense Academy (CDA) run by the Singapore Civil Defense Force (SCDF), which is one of the highest-level facilities of its kind in Asia. In an effort to utilize their expertise and facilities, ADRC has invited related officers from member countries to attend the training course since 2001. Two officers from Mongolia and Thailand attended in 2012, and two participants will be selected to take the course in 2013.

List of countries sending attendees over the last 5 years
FY 2008 (4): Bhutan, Thailand, Kazakhstan, Mongolia
FY 2009 (2): Armenia, Sri Lanka
FY 2010 (3): Bhutan, Mongolia, the Maldives
FY 2011 (2): Bangladesh, Russia
FY 2012 (2): Mongolia, Thailand


Urban search-and-rescue training in Singapore

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.)

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							✓
Training and research							✓
Resource mobilization or regional collaboration							

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Visiting Researchers from ADRC Member Countries

The Asian Disaster Reduction Center (ADRC) has been hosting Visiting Researchers (VRs) from member countries since 1999, and 71 officials have so far taken part in the program to learn about Japan's advanced expertise and technology in the field of disaster risk reduction (DRR). After finishing the program, attendees are expected not only to contribute to strengthening DRR capacity in their home nations but also to further promote cooperation between their countries and ADRC. In 2013, eight Visiting Researchers from the member countries shown below were hosted.

FY	Name	Country
2013	Mr. Thaufeeq Ibrahim	Maldives
	Ms. Chinbaatar Lkhamjav	Mongolia
	Ms. Thandar Aung	Myanmar
	Mr. Thashpulatov Mansurjon	Uzbekistan
	Mr. Islam Mohammad Manirul	Bangladesh
	Mr. Pema Thinley	Bhutan
	Mr. Leng Heng An	Cambodia
	Mr. Bakhtiari Ali	Iran

Visiting Researchers

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR				✓			
Training and research				✓			
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

13th Typhoon Committee Attachment Training at the RSMC Tokyo – Typhoon Center

The RSMC Tokyo – Typhoon Center has organized ESCAP/WMO Typhoon Committee Attachment Training sessions every year since 2001 with the support of the WMO Tropical Cyclone Programme (TCP) and the Typhoon Committee to enhance the capacity of Committee members in typhoon analysis and forecasting.

This year, Mr. Monichoth So Im from Cambodia and Mrs. Roongrawee Onkot from Thailand attended the 13th Attachment Training session held at JMA Headquarters from 17 to 26 July, 2013. The training focused on improving skills in tropical cyclone analysis and forecasting through practical training, including hands-on learning using the Satellite Analysis and Viewer Program (SATAID). It also incorporated lectures on a variety of subjects, such as quantitative precipitation estimation (QPE) and quantitative precipitation forecasting (QPF), the basics of storm surge, the Severe Weather Forecasting Demonstration Project (SWFDP), and the basics of Japan's next generation of meteorological satellites (Himawari-8/9).

During the sessions, the two trainees also attended daily tropical weather briefings to discuss the outlook for tropical cyclone formation and development in the western North Pacific region using real-time data including MTSAT images as well as numerical weather prediction (NWP) output.

The training was successful in deepening the trainees' basic understanding of operational TC monitoring, analysis and forecasting together with practical skills in TC monitoring and analysis.

Identified opportunities/challenges, if any, for further development or collaboration:

The trainees also expressed a need for more opportunities to learn how to use SATAID for satellite analysis as well as NWP models. Due to budgetary constraints, only two Typhoon Committee Members are currently invited every year in alphabetical rotation from Cambodia to Viet Nam. This means that each Member can send a representative to RSMC attachment training only once every seven years.

As mentioned at the 45th Typhoon Committee session, considering the widening gap between developed and developing Committee Members in recent years, the Committee may place higher priority on developing countries (including Cambodia, Lao People's Democratic Republic, Malaysia, the Philippines, Thailand and Viet Nam) as training targets to reduce the gap.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology	✓	✓		✓	✓	✓	
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

Experimental operation of Cloud Grid Information Objective Dvorak Analysis (CLOUD)

Since 1984, RSMC Tokyo has operationally used the Dvorak technique as the primary tool for determining TC intensity. In 2001, the Center incorporated the early-stage Dvorak analysis (EDA) technique developed by JMA into its operations to detect tropical disturbances with the potential to develop into TCs. Despite including inherent subjectivity, these techniques provide reasonable and reliable estimates of the intensity or likelihood of development to TS level in most cases. However, such subjectivity can be reduced by increasing the time frame and spatial resolution of satellite images and by enhancing the expertise of TC forecasters (particularly in regard to the determination of cloud patterns/central positions and the identification of convective cloud areas).

To minimize the subjectivity of Dvorak analysis, RSMC Tokyo developed an algorithm to support the objective calculation of T-numbers covering both EDA and Dvorak analysis stages. This is referred to as Cloud Grid Information Objective Dvorak Analysis (CLOUD). Details of CLOUD, including verification results, were published in the RSMC Technical Review in March 2013 (http://www.jma.go.jp/jma/jmaeng/jma-center/rsmc-hp-pub-eg/techrev.htm). CLOUD is unique for its utilization of TC Cloud Grid Information (CGI; a product operationally produced by the Meteorological Satellite Center (MSC) since 2007) to accurately identify convective cloud areas. CLOUD uses TC center positions and cloud patterns manually determined by operational forecasters as input because such data are considered more reliable than information determined using objective methods.

CLOUD verification was performed with 1,944 cases to which the RSMC applied Early Dvorak and Dvorak Analysis from 2011 to August 2013. The results showed that 1,683 cases (87%) had T-number differences of 0.5 or less in the best Dvorak analysis conducted by the RSMC, whereas 261 cases (13%) had differences of 1.0 or greater. These results indicate that CLOUD T-numbers are as accurate as their manual counterparts and can be used as final T-numbers except in cases of: 1) CGI identification of convective cloud areas significantly different from manually identified ones; 2) low concentration of convective cloud areas around a TC center; 3) shear patterns; or 4) rapid intensification. These shortcomings of CLOUD can be overcome by adopting manually determined PT (Pattern T) or MET (Model Expected T-number) data as appropriate.

Identified opportunities/challenges, if any, for further development or collaboration:

Although CLOUD increases the objectivity of TC analysis and reduces the burden of operational forecasters, its accuracy still largely depends on the appropriate manual determination of TC central positions and cloud patterns, and the correct choice of the final T-number among CLOUD, PT and MET data. Adequate understanding of how digital T-numbers are derived according to Dvorak analysis (1984) is also indispensable for forecasters in understanding the CLOUD algorithm so that it can be used appropriately.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology	✓	✓		✓	✓		✓
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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Recent developments and upgrade plans for JMA's global NWP system

1. Plans to upgrade JMA's global numerical weather prediction system

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 its top level will be raised from 0.1 hPa to 0.01 hPa. The higher vertical resolution is expected to improve the representation of atmospheric vertical structure and atmospheric processes. This applies particularly in the boundary layer, which is quite important in tropical cyclone (TC) forecasting with numerical weather prediction models. Raising the model's top level will enable better usage of satellite data channels, which are sensitive to middle-atmosphere conditions, in data assimilation. Physical processes such as the cumulus convection scheme, boundary layer scheme and long wave radiation scheme will be revised, and a non-orographic gravity wave drag scheme will be introduced to improve forecast performance.

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 horizontal resolution enhancement in the forecast model from TL319 to TL479 and an ensemble size increase 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. The results of related experiments covering the period from 5 June to 28 December, 2012, showed that the upgrade will have a positive impact on TC track forecasts in both ensemble mean and control runs, as shown in the figure shown here.

2. Global NWP data assimilation system improvements

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 has applied or plans to apply the following improvements:

(1) Upgrade of the radiative transfer model for satellite radiance data assimilation (November 2012)

The radiative transfer model used in the DA system as an observation operator for satellite radiance data assimilation was upgraded from RTTOV-9.3 to RTTOV-10 in November 2012. 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) Upgrade of global navigation satellite system (GNSS) radio occultation (RO) data usage (December 2012)

GNSS RO refractivity data were previously assimilated with a bias correction scheme from March 2007 onward. However, it was found necessary to revise the observation operator in the algorithms used to convert the vertical interpolation of geopotential height. A 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. Based on this result, the upgrade was applied to the operational system in December 2012.

(3) Enhancement of utilized atmospheric motion vectors (AMVs) (July 2013)

In addition to AMVs from five geostationary satellites and the Terra/Aqua polar orbiting satellites, AMVs from geostationary-polar composite imagery (LEOGEO) and AMVs derived from the Advanced Very High Resolution Radiometer (AVHRR) on board the NOAA and Metop satellites have been utilized in the global NWP system since July 2013. The LEOGEO AMVs fill the gap between those from geostationary satellites and polar orbiting satellites, and enable better wind field analysis for latitudes around 60°.

(4) Introduction of the Advanced Microwave Scanning Radiometer-2 (AMSR2) on board the Global Change Observation Mission 1st – Water (GCOM-W1; Japanese name: Shizuku) (September 2013)

GCOM-W1 is an earth observation satellite operated by the Japan Aerospace Exploration Agency (JAXA) with the AMSR2 unit on board. Because of its afternoon orbit, it fills gaps in microwave imager coverage by the Special Sensor Microwave Imager Sounders (SSMISs) used on the Defense Meteorological Satellite Program (DMSP) F16, 17, 18, which are in early morning or morning orbit. The results of observation system experiments conducted in advance for AMSR2 show a positive impact on rainfall prediction. Based on these outcomes, AMSR2 was introduced as part of the operational system in September 2013.

(5) Introduction of data from Metop-B (near future)

Metop-B has been the EUMETSAT primary polar orbiting satellite since April 2013. The results of an observation system experiment conducted for the payloads of Metop-B (AVHRR AMVs, AMSU-A, MHS, ASCAT and GRAS) showed a positive impact on geopotential height forecasts in the mid latitudes and typhoon track forecasts.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology	✓	✓		✓		✓	
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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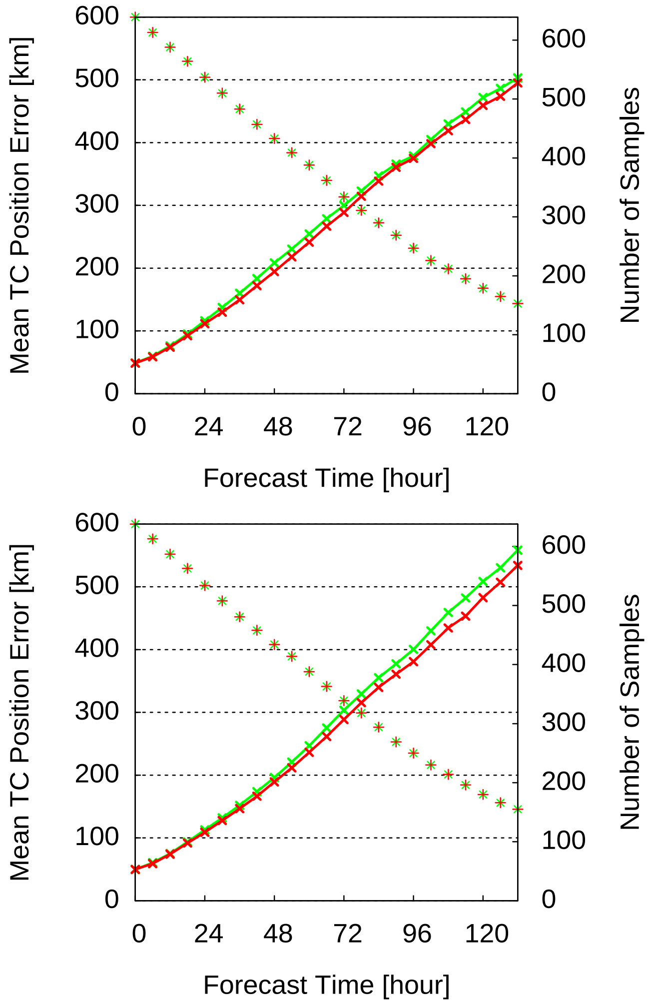


Figure Mean TC position errors (in km) of the ensemble mean (left) and control runs (right) as a function of forecast time up to 132 hours. The red and green lines indicate the errors of the upgraded Typhoon EPS (TL479, 25 members) and those of the operational Typhoon EPS (TL319, 11 members), respectively. The dots correspond to the vertical axis on the right, which represents the number of verification samples.

Himawari-8/9 – Japan's next generation of geostationary meteorological satellites

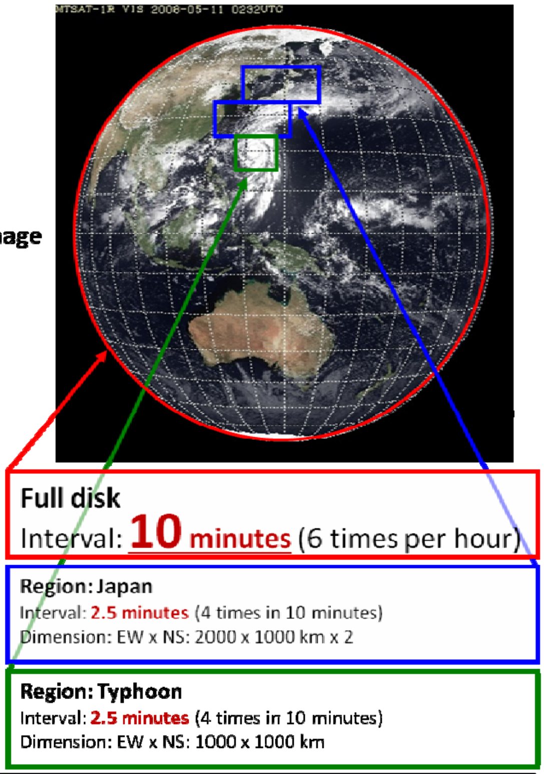
The Japan Meteorological Agency (JMA) has operated a series of satellites at around 140 degrees east for more than 35 years since Japan's first meteorological satellite was launched in 1977. The currently operational MTSAT-2 is backed up by MTSAT-1R in stand-by orbit.

JMA plans to launch Himawari-8 in 2014 as a next-generation satellite and to start its operation in 2015 as a replacement for MTSAT-2. Himawari-9 will also be launched in 2016 as a backup and successor satellite. Both satellites will be located at around 140 degrees east, and will continue to observe the East Asia and Western Pacific regions for a period of 15 years.

Channels of Himawari-8/9

Channel	Central Wavelength [μm]	Spatial Resolution	
1	0.43 – 0.48	1 km	RGB Composited True Color Image
2	0.50 – 0.52	1 km	
3	0.63 – 0.66	0.5 km	
4	0.85 – 0.87	1 km	
5	1.60 – 1.62	2 km	
6	2.25 – 2.27	2 km	
7	3.74 – 3.96	2 km	
8	6.06 – 6.43	2 km	Water Vapor
9	6.89 – 7.01	2 km	
10	7.26 – 7.43	2 km	
11	8.44 – 8.76	2 km	SO_2
12	9.54 – 9.72	2 km	O_3
13	10.3 – 10.6	2 km	Atmospheric Windows
14	11.1 – 11.3	2 km	
15	12.2 – 12.5	2 km	
16	13.2 – 13.4	2 km	CO_2

Number of Channels: 5 → 16



Interval: 30/60 min. → 10 min.

Himawari-8/9 will have 16 channels, which is more than triple the 5 channels of the MTSAT series. Three of these will be visible channels corresponding to red, green and blue to enable the creation of true-color images. Observation frequency will also be enhanced, with full-disk imagery obtained every 10 minutes. In addition, rapid scanning will be conducted in several regions, one of which will be for targeted observation of tropical cyclones. JMA expects this rapid scanning to be especially useful for East Asian and Western Pacific countries.

Himawari-8/9 will not carry a device for direct dissemination. Instead, all imagery derived from the satellites will be distributed via the Internet. JMA will also disseminate a limited imagery data set via a telecommunication satellite for users with limited Internet access, and tentatively plans to begin this service in 2015 in parallel with the direct dissemination of imagery from MTSAT-2 via MTSAT-1R. In the spring of 2014, JMA will release more information on these services, including details of the equipment required to receive imagery via a telecommunication satellite.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.)

KRA =	1	2	3	4	5	6	7
Meteorology						✓	
Hydrology						✓	
DRR						✓	
Training and research							
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

Development of a radar composite map for Thailand

The exchange of radar data among TC Members has long been considered very important in terms of improving quantitative precipitation estimation (QPE) and quantitative precipitation forecasting (QPF) capability in the region.

In September 2011, radar experts from JMA, Kyoto University and the Typhoon Committee Secretariat went to Thailand to investigate the capacity of the Thai Meteorological Department (TMD) with a view to establishing a radar composite map covering Thailand.

In November 2012, JMA organized an attachment training course in Tokyo on radar composite techniques for TMD experts based on a TMD progress report. It was recommended that TMD work on the development of techniques for the creation of quality-assured radar echo intensity data on the lowest level at one radar site in 2013.

After extensive email communications between JMA and TMD regarding technical matters, JMA plans to hold a technical meeting in Tokyo on the radar composite map in November 2013 to focus on the creation of an elevation angle composite table that will assist TMD in developing the map.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology						✓	✓
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

Enhancement of Storm Surge Information for Typhoon Committee Members

The Japan Meteorological Agency (JMA) introduced improved storm surge forecasts for Typhoon Committee (TC) Members on 3 June, 2013. The forecast region of the storm surge model was extended, and seven stations were added to support storm surge time-series forecasting services. These improvements were made in line with recommendations included in the Annual Operating Plan 2013 of the TC Working Group on Meteorology.

The new forecasting region, which is almost twice as large as the previous one, covers the area from 95 to 160°E longitude and 0 to 46°N latitude and includes the Mariana Islands and most of the Caroline Islands. This extension enables various users to understand the general characteristics of forthcoming storm surges, thereby supporting the issuance of early warnings and helping users in the extension area to access forecasts for the issuance of local warnings and advisories.

The additional stations for time-series forecast services are at Chumphon (Thailand), Boryeong, Busan, Incheon, Jeju, Mokpo and Sokcho (Republic of Korea). JMA is currently preparing to add further stations in response to requests from TC Members in due course.

This service is provided within the framework of the WMO Storm Surge Watch Scheme (SSWS), and real-time storm surge forecasts are provided on JMA's Numerical Typhoon Prediction website (https://tynwp-web.kishou.go.jp/) when one or more typhoons are present in the region.

Identified opportunities/challenges, if any, for further development or collaboration:

JMA plans to add more stations at the request of members, with several stations in the Philippines and Vietnam scheduled for inclusion before the next typhoon season. Further requests from TC Members are welcomed.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology	✓	✓		✓		✓	
Hydrology				✓			
DRR							
Training and research							
Resource mobilization or regional collaboration							

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TCC products and publications related to tropical cyclones

The Tokyo Climate Centre (TCC) issues weekly reports on extreme climate events around the world, including extremely heavy precipitation and/or weather-related disasters caused by tropical cyclones (http://ds.data.jma.go.jp/gmd/tcc/tcc/products/climate/).
In addition, 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. 34, covers the higher-than-normal frequency seen in the formation of tropical cyclones of tropical storm (TS) intensity or higher over the western North Pacific in 2013, and refers in particular to two typhoons that caused fatalities in Viet Nam and China (http://ds.data.jma.go.jp/tcc/tcc/news/tccnews34.pdf).

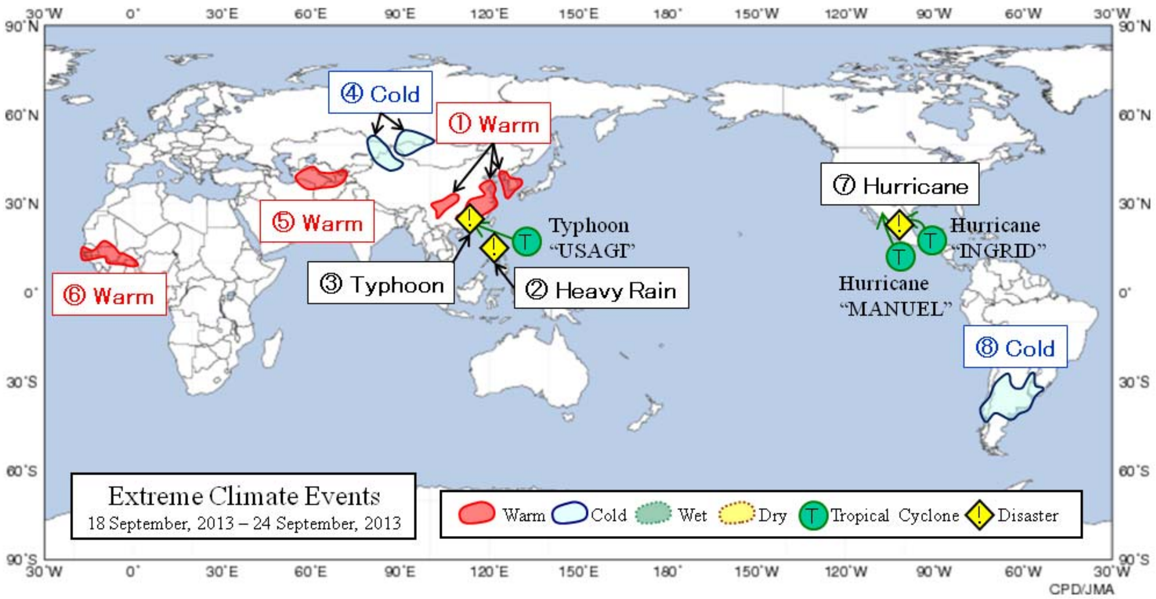

Figure Distribution of global extreme climate events (18 – 24 September, 2013)
The figure highlights areas where extreme climate events were identified from SYNOP messages, and also shows the tracks of tropical cyclones based on preliminary data from tropical cyclone centers worldwide.

<u>Summary Table</u> of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology	✓	✓		✓	✓		
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

Interactions between Typhoon Choi-wan (2009) and the Kuroshio Extension system

MRI/JMA investigated interactions between Typhoon Choi-wan (2009) and the Kuroshio Extension system using a coupled atmosphere-wave-ocean model via 14 numerical simulations performed with initial conditions obtained from daily oceanic reanalysis data for the northwestern Pacific Ocean from September 12 to September 25, 2009. Pre-existing oceanic conditions affected the simulated central pressure. Among the simulations, the central pressure range during the mature phase was up to 10 hPa. In addition, the sensitivity of preexisting oceanic conditions to the inner-core axisymmetric structure of the simulated typhoon differed among the intensification, mature and decaying phases. However, preexisting oceanic conditions had little impact on the simulated track. Variations in pre-existing oceanic conditions in the Kuroshio Extension region in the simulated atmospheric and oceanic horizontal fields affected the typhoon and a nearby stationary front differently. Around the stationary front in particular, the impact on hourly precipitation was closely related to that on surface wind speed, whereas the impact on surface temperature was greatly affected by that on sea surface temperature through the change in latent heat fluxes.

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research						✓	
Resource mobilization or regional collaboration							

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TC Members' Report
Summary of Progress in KRAs

Tropical cyclone activity prediction using TIGGE data

MRI/JMA has begun evaluating tropical cyclone genesis prediction on a medium-range timescale using TIGGE data under the North Western Pacific Tropical Cyclone Ensemble Forecast Project (NWP-TCEFP). This study is one of the annual operating plans (AOPs) of the Working Group on Meteorology (WGM) for 2013.

In line with WGM AOP 2013, tropical cyclone (TC) activity predictions are evaluated for TCs generated between July and October in the period from 2009 to 2012 using ensemble predictions from ECMWF, JMA, NCEP and UKMO. Evaluation of activity prediction involves verification of the presence of simulated TCs for a certain area (e.g., a 10 × 10 deg. grid box space) and for a certain forecast time window (Vitart et al. 2010). The forecast time window is set at three days and is applied over a forecast length of two weeks with one-day increments. Given that the average lifetime of typhoons is about five days, the results can be seen as verification of TC genesis and the subsequent tracks in the second- week predictions if the verification region is set to low latitudes.

When the verification area is set to the east of the Philippines, the Brier Skill Scores (BSSs) for all NWP centers are positive at least up to day nine, indicating more skillful predictions than the climatology. In the South China Sea, for example, ECMWF and UKMO Ensemble Prediction System (EPS) show positive BSSs throughout the two-week period. In verification for individual TC cases, all EPSs successfully predicted genesis events with a lead time of at least five days, and more in some cases (e.g., Typhoon Son-tinh in 2012), while some cases show less predictability (e.g., Typhoon Nalgae in 2011).

Summary Table of relevant KRAs and components (Tick the boxes as appropriate; multiple selections may be made if necessary.):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research						✓	
Resource mobilization or regional collaboration							

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