MEMBER REPORT

ESCAP/WMO Typhoon Committee
11th Integrated Workshop

(MALAYSIA)

CONTENTS

I. Overview of tropical cyclones which have affected/impacted Malaysia in 2016

1. Meteorological Assessment (highlighting forecasting issues/impacts)

In total eight typhoons and ten tropical storms (tropical storm intensity or higher) developed over the western Pacific Ocean, the Philippines region, and the South China Sea from January to September 2016. The occurrence of typhoon and tropical storm were active in the month of August and September 2016 where seven typhoon and seven tropical storm were recorded. The observed typhoons and tropical storms are listed along with details regarding their lifetimes, regions of formation, starting and ending dates as well as their highest wind speeds in **Table 1**.

Eight typhoons and ten tropical storms, respectively, warranted the issuance of strong wind/rough sea warnings over marine regions under the responsibility of the Malaysian Meteorological Department (MMD). **Table 2** recounts the number of warnings issued by MMD for each typhoon and tropical storm. The map of Malaysia territorialwater and the trajectories of the six typhoons or tropical storms closest to Malaysia are illustrated in **Figure 1a** and **Figure 1b**. However, none of these typhoons or tropical storms was close enough to directly or indirectly cause significant loss of neither life nor properties within Malaysia.

The impacts of typhoons and tropical storms over the Malaysian region were restricted to rainfall events and gusting due to the tail effect of the typhoons and tropical storms. The tail effect is generally responsible for enhancing afternoon convective weather over Malaysia, especially in northern Peninsular Malaysia, Sabah and coastal Sarawak. The satellite imageries of rain cloud clusters centered upon the Malaysian region during the transits of typhoon or tropical storms close to Malaysia are shown in **Figure 2.** The images were derived from the Himawari satellite infra-red channel. The other typhoons and tropical storms which are not shown in **Figure 1** and **Figure 2** are located too far away to have any significant impact on Malaysia.

Figure 3 illustrates the wind flow at 850hPa atmospheric pressure level during the transits of typhoons or tropical storms closest to Malaysia. The charts were derived from the Global Forecast System (GFS) analysis. Daily rainfall graphs of chosen meteorological stations in the northern Peninsular and east Malaysia were used to depict rainfall events induced by the tail effect of typhoons and tropical storms. Monthly rainfall charts in July, August and September 2016 covering the typhoon or tropical storm events affecting the country are shown in **Figures 4a** to **4h**.

Qualitative analysis of **Figure 2** (satellite imageries) as well as **Figures 4a** to **4h** (daily rainfall charts) revealed rain cloud bands associated with typhoons and tropical storms over Malaysia. The rainfall charts of July 2016 (Figure 4a) showed moderate distribution of rainfall amount along the month except at the north of Peninsular Malaysia where it contributed more rain in mid of July 2016. Meanwhile in East Malaysia, a significant amount of rainfall was observed along the month. This may correlated with the occurrence of typhoon Mirinae.

The satellite imageries in **Figure 2**, alsodisplayed the tail effect of typhoon Meranti over Malaysia and subsequent examination of rainfall charts in **Figures 4e** to **4f** showed spikes in daily rainfall over all selected stations in the north of Peninsular Malaysia. Nevertheless, typhoons and tropical storms are not the only factors contributing to heavy rainfall in Malaysia. There are cases whereby severe rainfall occurred during typhoon events but may not be associated with it.

Table 1: List of typhoons and tropical storms with JTWC classification, date of birth and death and maximum wind from January to September 2016

No.	Tropical Cyclone	JTWC Classification	Date		Max Wind (knots)
			Birth (UTC)	Death (UTC)	
1.	NEPARTAK*	Typhoon	03/07/2016	09/07/2016	110
2.	LUPIT*	Tropical Storm	23/07/2016	24/07/2016	40
3.	MIRINAE@	Tropical Storm	26/07/2016	28/07/2016	55
4.	NIDA#	Tropical Storm	30/07/2016	02/08/2016	60
5.	OMAIS*	Tropical Storm	04/08/2016	09/08/2016	60
6.	CONSON*	Tropical Storm	09/08/2016	15/08/2016	45
7.	CHANTHU*	Tropical Storm	13/08/2016	17/08/2016	55
8.	DIANMU@	Tropical Storm	17/08/2016	19/08/2016	40
9.	MINDULLE*	Typhoon	19/08/2016	23/08/2016	65
10.	LIONROCK*	Typhoon	19/08/2016	30/08/2016	90
11.	KOMPASU*	Tropical Storm	20/08/2016	21/08/2016	35
12.	NAMTHEUN#	Typhoon	01/09/2016	05/09/2016	75
13.	MALOU#	Tropical Storm	06/09/2016	07/09/2016	40
14.	MERANTI*	Typhoon	10/09/2016	15/09/2016	120
15.	RAI@	Tropical Storm	12/09/2016	13/09/2016	35
16.	MALAKAS*	Typhoon	12/09/2016	20/09/2016	95
17.	MEGI*	Typhoon	23/09/2016	28/09/2016	85
18.	CHABA*	Typhoon	27/09/2016	05/10/2016	115

Remarks:

1. Number of tropical cyclones originated from:
   - * Western Pacific Ocean region: 12
   - ! Central Pacific region: -
   - # Phillipines region: 3
   - @ South China Sea region: 3

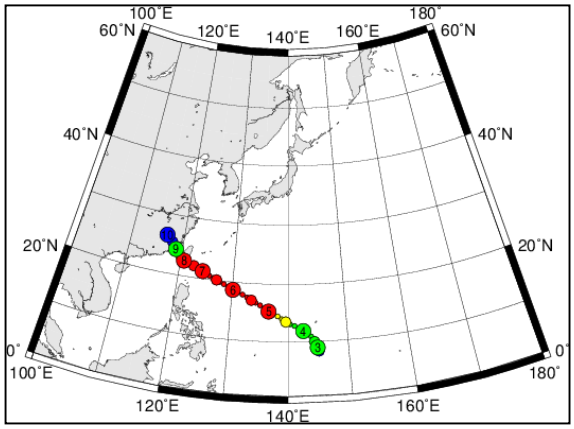
2. JTWC: Joint Typhoon Warning Centre

Table 2: Tropical Cyclone Advisories and Warnings Issued by MMD from January to September 2016

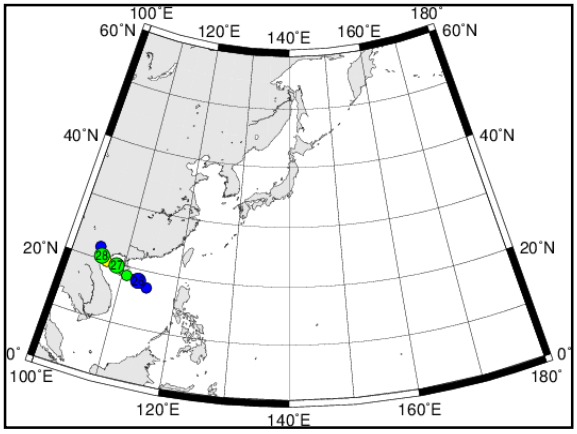
No.	Name	Category	Date		Total No. of Strong Wind / Rough Seas Warnings due to Tropical Cyclones (area affected)
			Start	End	
1	NEPARTAK	Typhoon	03/07/2016	09/07/2016	23 (Sarawak, Straits of Malacca, Sulu, Pahang, Kelantan, Terengganu, Phuket, Reef North, Palawan, Sulawesi, Layang-layang, FT Labuan, Samui&Tioman)
2	LUPIT	Tropical Storm	23/07/2016	24/07/2016	8 (Phuket, Straits of Malacca, Reef North, Reef South, Bunguran, FT Labuan &Condore)
3	MIRINAE	Tropical Storm	26/07/2016	28/07/2016	12 (Reef North, Reef South, Layang-layang, Samui, FT Labuan, Condore, Sulu, Palawan, Sulawesi, Tioman& Phuket)
4	NIDA	Tropical Storm	30/07/2016	02/08/2016	19 (Phuket, Straits of Malacca, Reef South, FT Labuan, Palawan, Reef North, Condore, Sulu, Sulawesi, Bunguran, Samui&Layang-layang)
5	OMAIS	Tropical Storm	04/08/2016	09/08/2016	25 (Phuket, Straits of Malacca, Condore, Reef North, Palawan, FT Labuan, Sulu, Layang-layang, Bunguran, Samui, Tioman& Sabah)
6	CONSON	Tropical Storm	09/08/2016	15/08/2016	17 (Phuket, Condore, Reef North, Layang-layang, Palawan, Samui, Tiomandan FT Labuan)
7	CHANTHU	Tropical Storm	13/08/2016	17/08/2016	2 (Reef North, Layang-layang, Palawan, Phuket, Condore& FT Labuan)
8	DIANMU	Tropical Storm	17/08/2016	19/08/2016	11 (Phuket, Palawan, Straits of Malacca, Tioman& Reef South)
9	MINDULLE	Typhoon	19/08/2016	23/08/2016	18 (Phuket, Palawan, Reef South, Reef North, Layang-layang, Straits of Malacca, Tioman, Condore, Sulu, Samui& FT Labuan)
10	LIONROCK	Typhoon	19/08/2016	30/08/2016	31 (Phuket, Palawan, Reef North, Layang-layang)
11	KOMPASU	Tropical Storm	20/08/2016	21/08/2016	9 (Phuket, Palawan, Reef South, Reef North, Layang-layang& Straits of Malacca)
12	NAMTHEUN	Typhoon	01/09/2016	05/09/2016	19 (Tioman, Reef South, Bunguran, Kuching, FT Labuan, Reef North, Straits of Malacca, Condore, Sulu, Phuket & Sulawesi)

13	MALOU	Tropical Storm	06/09/2016	07/09/2016	11 (Phuket, Straits of Malacca, Reef South, Reef North, FT Labuan, Sulu, Condore, Bunguran, Samui, Tioman& Kuching)
14	MERANTI	Typhoon	10/09/2016	15/09/2016	24 (Condore, Reef North, Reef South, Layang-layang, Palawan, FT Labuan, Sulu, Straits of Malacca, Sulawesi, Samui, Bunguran, Kuching, Tioman& Phuket)
15	RAI	Tropical Storm	12/09/2016	13/09/2016	-
16	MALAKAS	Typhoon	12/09/2016	20/09/2016	50 (Condore, Reef North, Layang-layang, Palawan, FT Labuan, Sulu,Phuket)
17	MEGI	Typhoon	23/09/2016	28/09/2016	22 (Straits of Malacca, Reef North, Reef South, FT Labuan, Layang-layang, Condore, Samui, Tioman, Sulu, Sulawesi, Bunguran, Palawan & Kuching)
18	CHABA	Typhoon	27/09/2016	05/10/2016	36 (Straits of Malacca, Condore, Reef North, Reef South, Sulu, Phuket, Layang-layang, Tioman, FT Labuan, Samui, Bunguran, Palawan & Sulawesi)

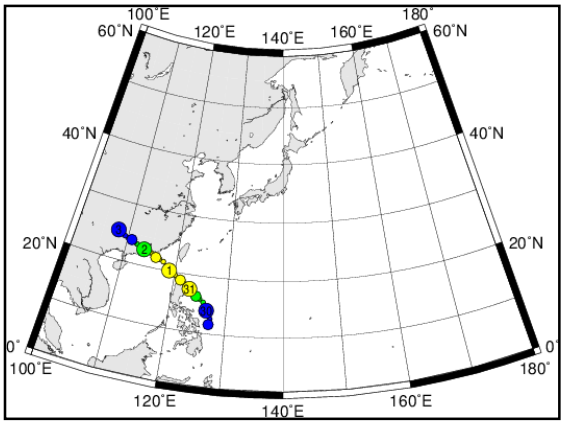
Figure 1a: Map of Malaysia territorial waters



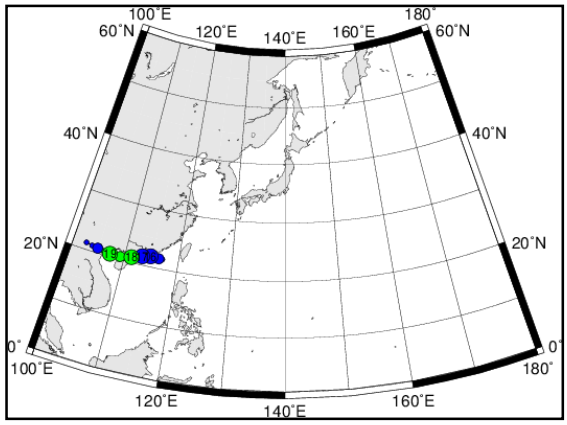
NEPARTAK



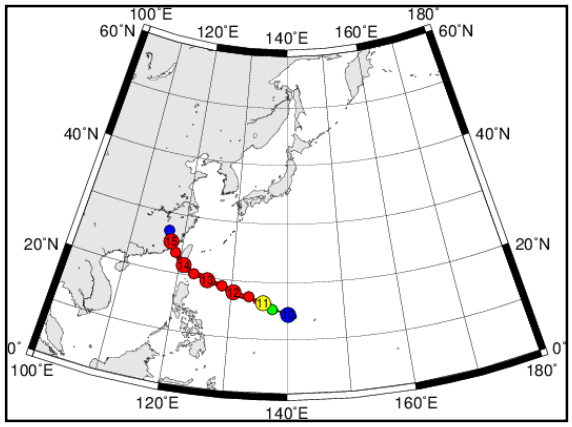
MIRINAE



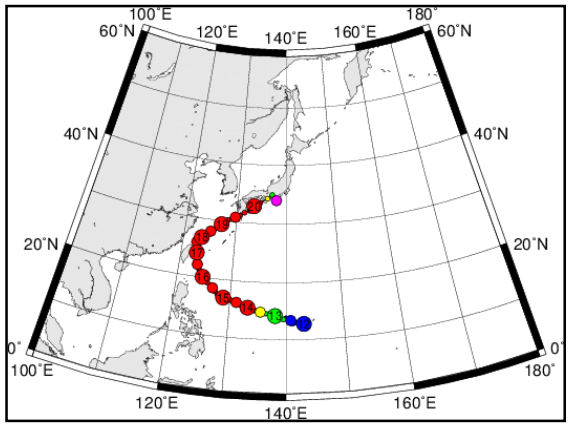
NIDA



DIANMU

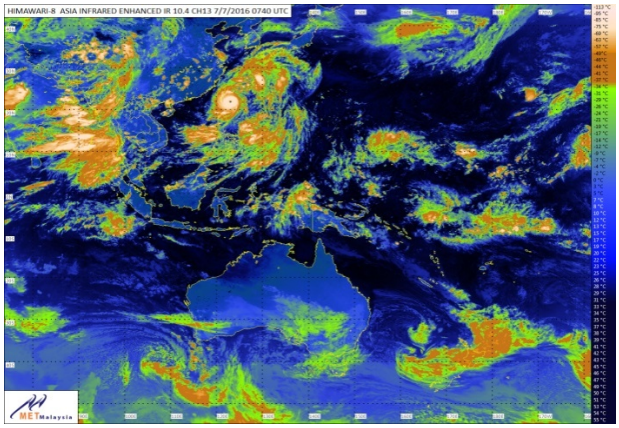


MERANTI

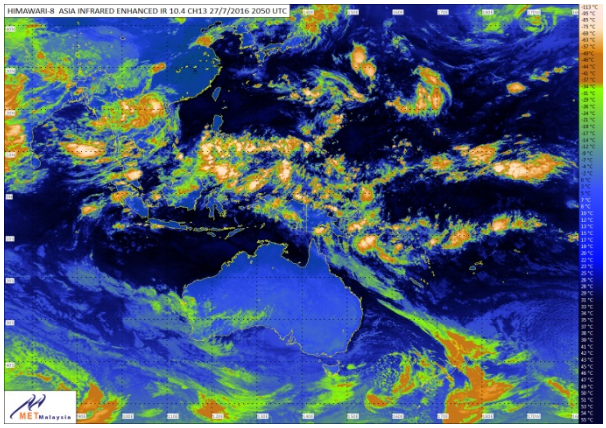


MALAKAS

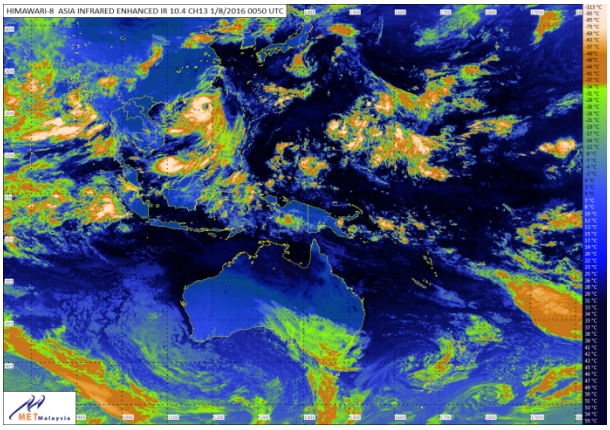
Figure 1b: Tracks of six typhoons and tropical storms affecting Malaysia from January until September 2016. The circled numbers represents the date of occurrence of the typhoons and tropical storms (Source: National Institute of Informatics (NII), Research Organization of Information and Systems (ROIS), Japan http://agora.ex.nii.ac.jp/digital-typhoon/latest/track).



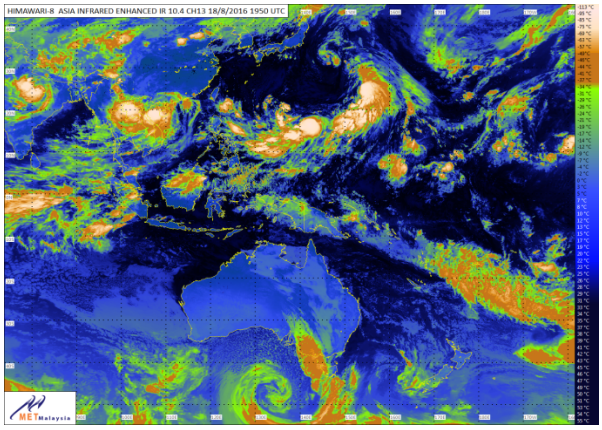
NEPARTAK
Image produced by Malaysian Meteorological Department on 07:40UTC 07/07/2016



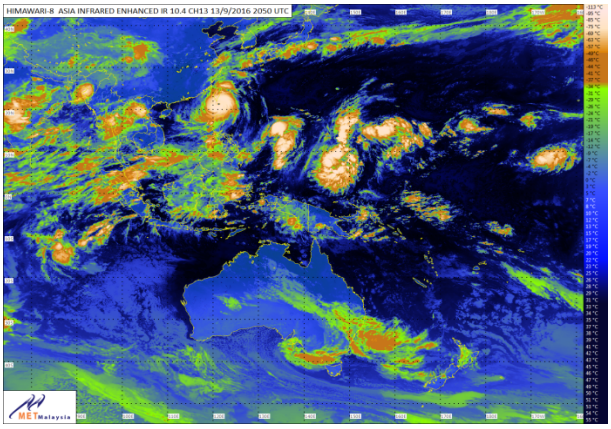
MIRINAE
Image produced by Malaysian Meteorological Department on 20:50UTC 27/07/2016



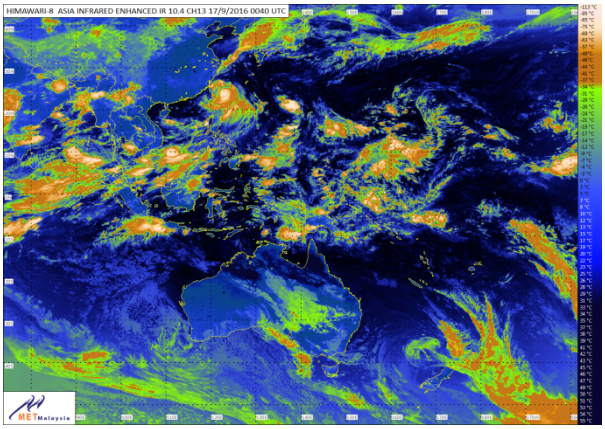
NIDA
Image produced by Malaysian Meteorological Department on 00:50UTC 01/08/2016



DIANMU
Image produced by Malaysian Meteorological Department on 19:50UTC 18/08/2016

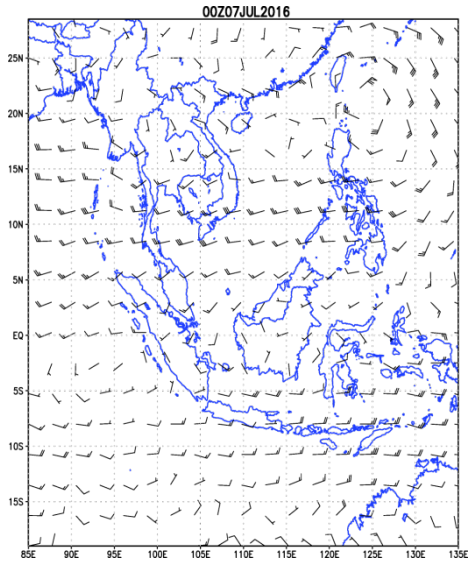


MERANTI
Image produced by Malaysian Meteorological Department on 20:50UTC 13/09/2016

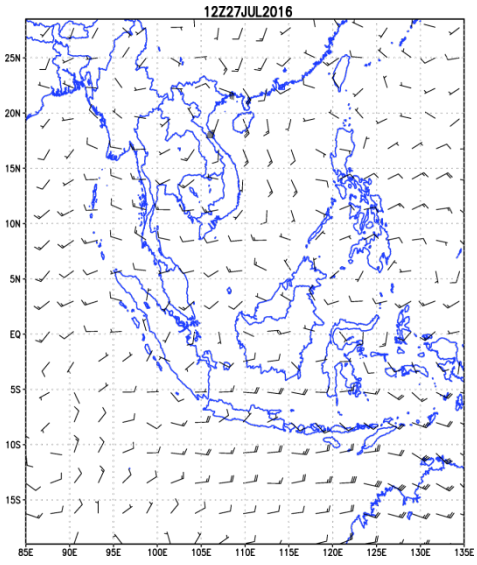


MALAKAS
Image produced by Malaysian Meteorological Department on 00:40UTC 17/09/2016

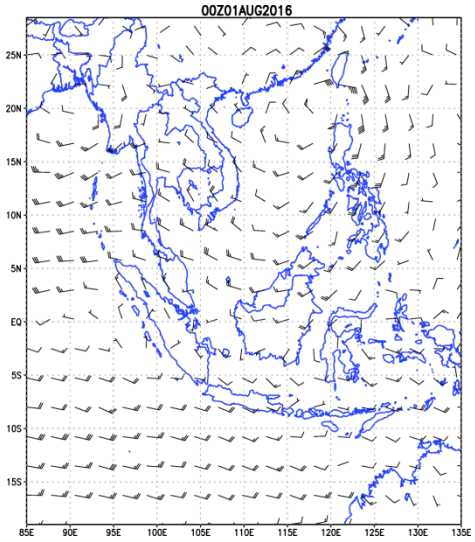
Figure 2: Himawari satellite imageries showing the rain cloud clusters associated with some of the selected tropical storms and cyclones over the Malaysian region



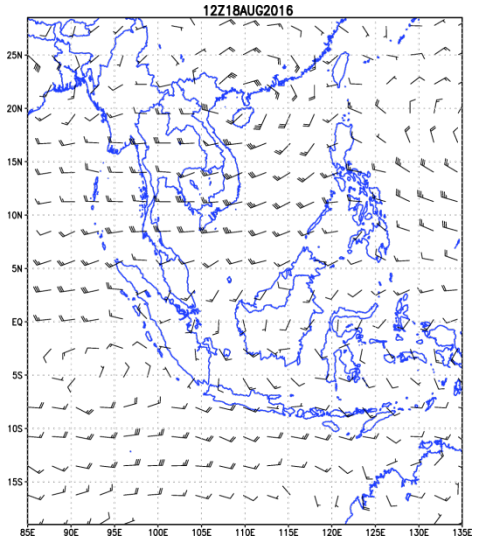
NEPARTAK



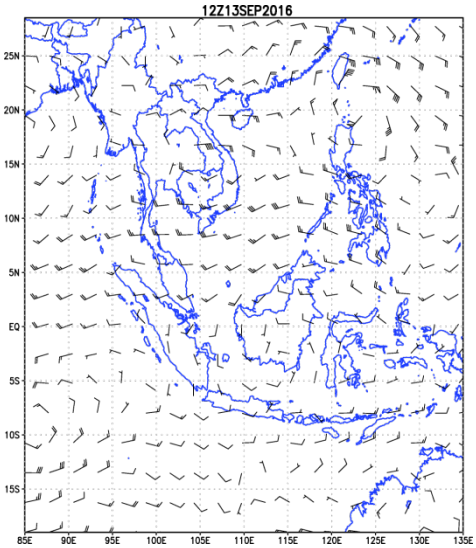
MIRINAE



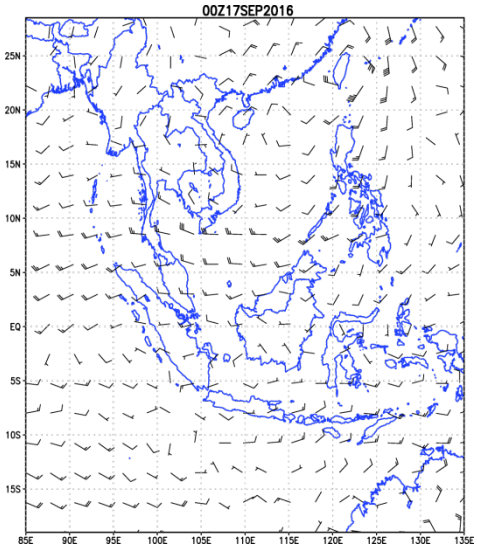
NIDA



DIANMU



MERANTI



MALAKAS

Figure 3: 850 hPa wind charts from the Global Forecast System showing wind patterns during the passage of typhoon Nepartak, tropical storms Mirinae, Nida and Dianmu followed by typhoons Meranti and Malakas.

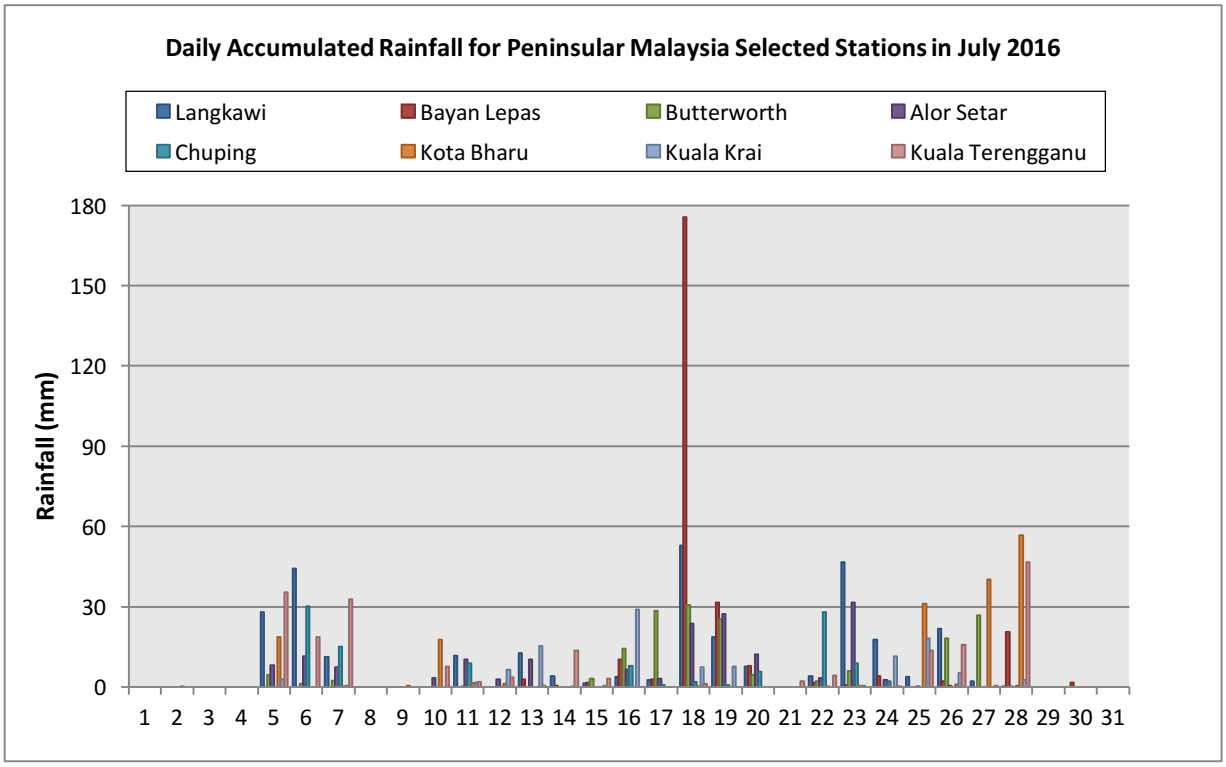


Figure 4a Daily rainfall chart of selected meteorological stations in Peninsular Malaysia for July 2016: Typhoon NEPARTAK (03/07/2016-09/07/2016), Tropical storms MIRINAE (26/07/2016-28/07/2016) andTropical storms NIDA (30/07/2016-02/08/2016)

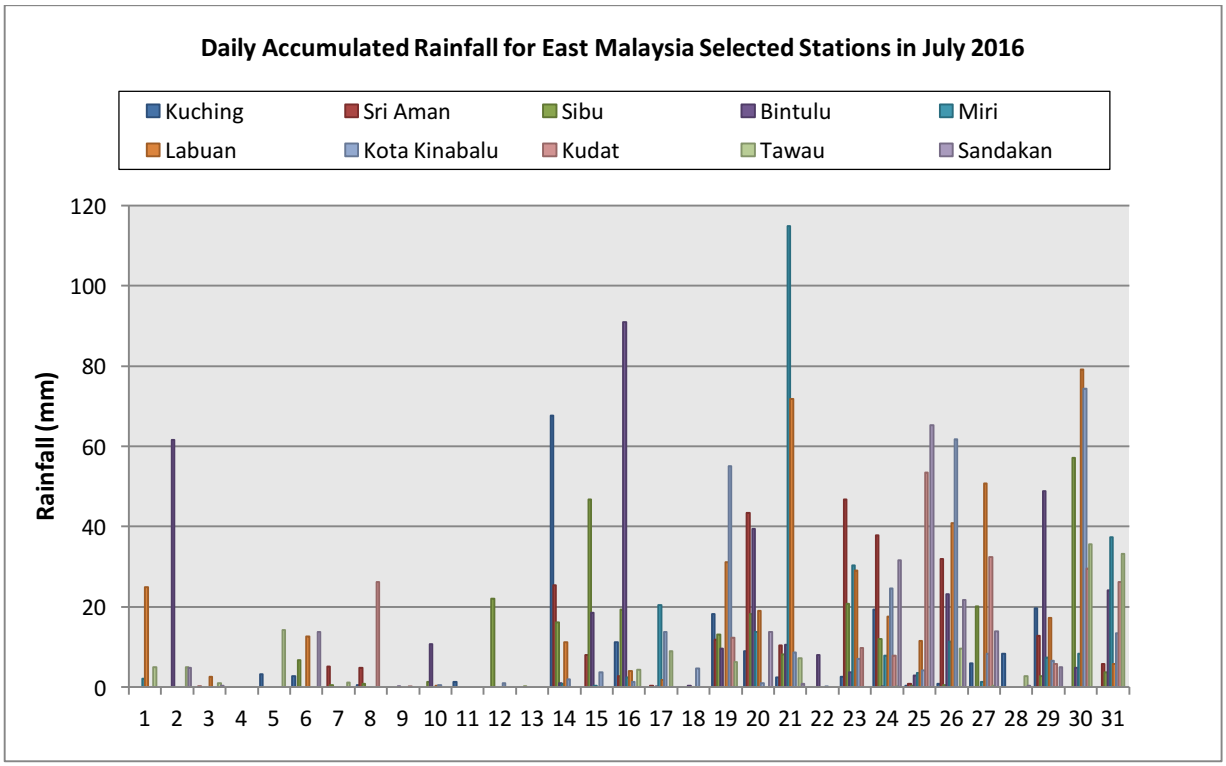


Figure 4b Daily rainfall chart of selected meteorological stations in East Malaysia for July 2016: Typhoon NEPARTAK (03/07/2016-09/07/2016), Tropical storms MIRINAE (26/07/2016-28/07/2016) and Tropical storms NIDA (30/07/2016-02/08/2016)

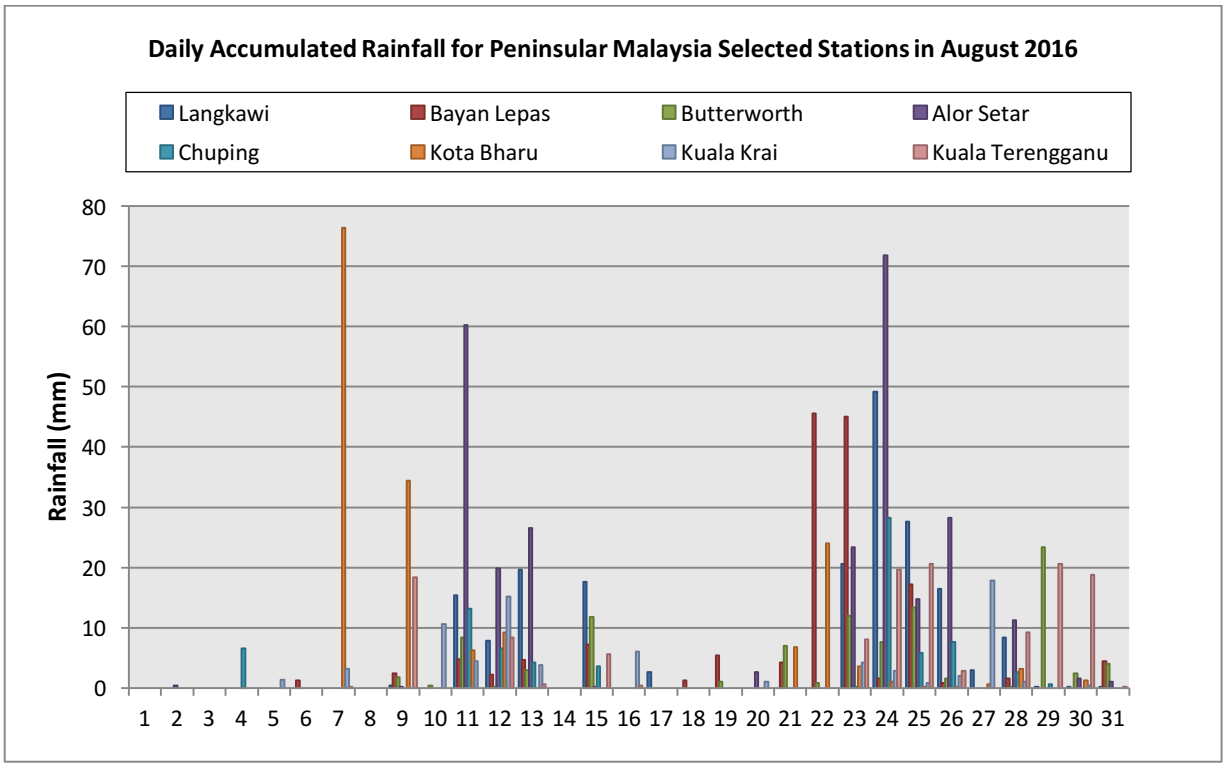


Figure 4c Daily rainfall chart of selected meteorological stations in Peninsular Malaysia for August 2016: Tropical Storm DIANMU (17/08/2016-19/08/2016)

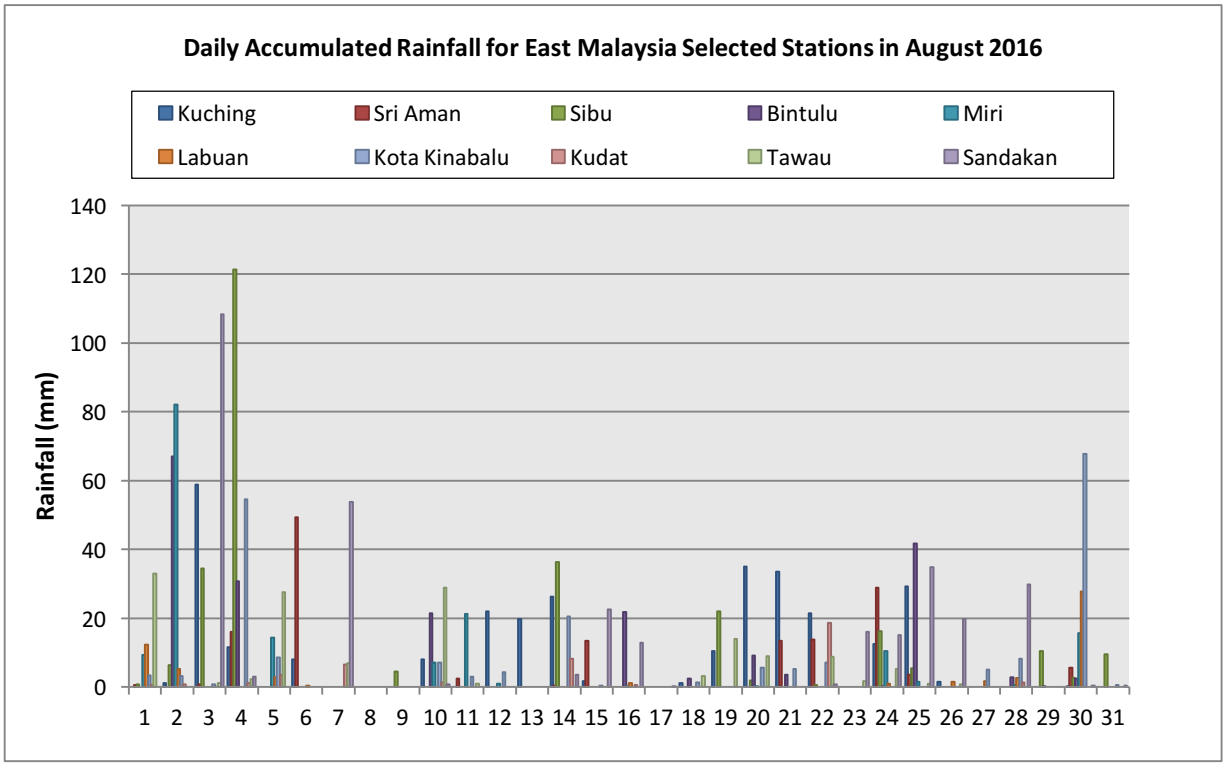


Figure 4d Daily rainfall chart of selected meteorological stations in East Malaysia for August 2016: Tropical Storm DIANMU (17/08/2016-19/08/2016)

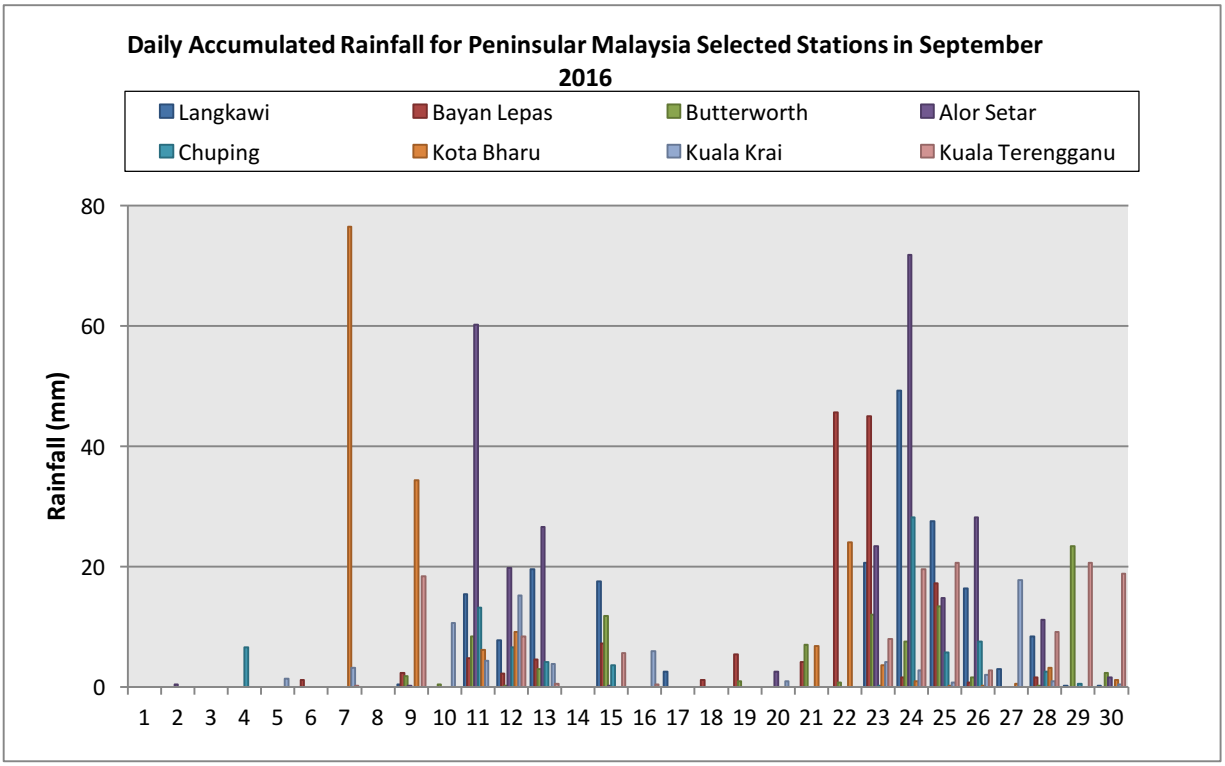


Figure 4e Daily rainfall chart of selected meteorological stations in Peninsular Malaysia for September 2016: Typhoon MERANTI (10/09/2016-15/09/2016) and Typhoon MALAKAS (12/09/2016-20/09/2016)

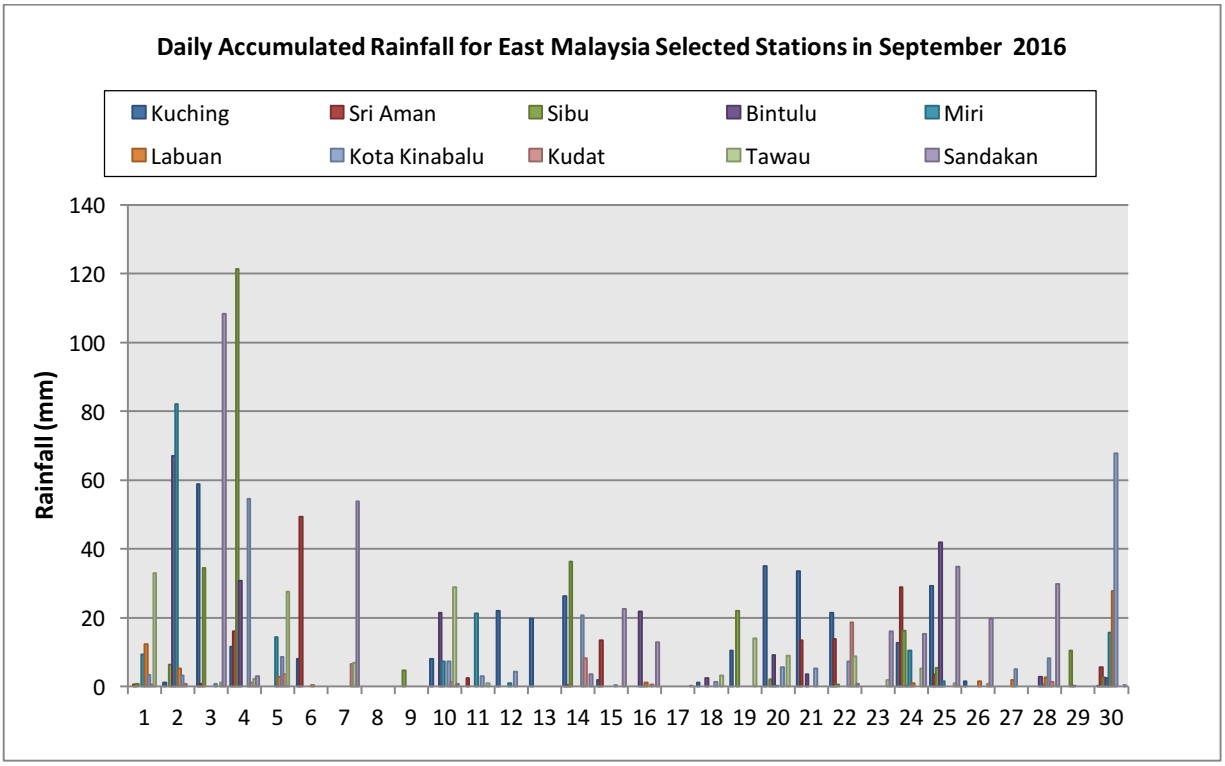


Figure 4f Daily rainfall chart of selected meteorological stations in East Malaysia for September 2016:Typhoon MERANTI (10/09/2016-15/09/2016) and Typhoon MALAKAS (12/09/2016-20/09/2016)

II. Summary of progress in Key Result Areas

1. Improvement of Weather and Typhoon Warning System

MMD continuously monitors weather and sea conditions within the Malaysian Exclusive Economic Zone (EEZ) covering the Straits of Malacca, South China Sea, Sulu Sea and the Celebes Sea. Additionally, sea and weather conditions outside the EEZ are also kept track of to identify meteorological and oceanographic events which may affect waters in the EEZ.

MMD receives satellite data from the HimawARI 8 (MTSAT replacement), FENG YUN, TERRA, AQUA, NOAA Series (NOAA-18 & 19), METOP A&B (Meteorological Operating) and NPP (National Polar Orbiting Partnership) from various satellite operators such as Japan, China and USA. Five ground receiving stations in Malaysia regularly receive data from these satellites. The raw data from various channels of different wave bands are processed to produce useful satellite images and observations of other meteorological parameters such as cloud image, cloud top temperature, cloud top height, cloud amount, sea surface temperature, normalized difference vegetation index (NDVI), hotspot, accumulated rainfall estimation and atmospheric motion vector (AMV). These information will act as supporting recipes for weather forecasters in providing more accurate advanced warnings of thunderstorms, flash floods, tropical cyclones and as well as for the purpose of haze monitoring and forecast of trans-boundary haze and other related phenomena.

MMD is implementing the now casting system SWIRLS. Radar nowcasting technology known as Short Range Warning of Intense Rainstorms in Localized Systems (SWIRLS) is operationalized in 11 radar stations throughout Malaysia. This technology was acquired from the Hong Kong Observatory (HKO) but tuned in-house for optimal results in Malaysia by MetMalaysia.SWIRLS uses an optical flow algorithm and backward semi-Lagrangian advection scheme to track the movement of radar echoes up to 3 hours ahead of time, based on past radar echoes. However, it does not account for the growth and decay of rain clouds over time. This approximation works well within a short period assuming that there is no change in thunderstorm cells.

MMD also is upgrading the automation of rainfall stations and integration of system. The project which is currently underway, extends the implementation of automation to unmanned remote rainfall stations. This stage also sees the relocation of existing stations to ensure a proper gridded surface network that enables a resolution of a 10km by 10km network. The project also is about the implementation of a new paradigm in the way data is transmitted from the stations. Implementing WMO standard codes revolutionizes the usual methods of transmitting hourly and daily extreme values using the rigid MMD Climate messages that were designed for manual methods of observation. Then, it includes the standardization of all algorithms for the calculation of meteorological elements. The implementation of these algorithms ensures quality of data.

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

MMD is in the process of extending the accuracy and forecast of SWIRLS up to 6 hours in advance through blending with numerical model output (NWP). Hourly NWP forecast will undergo intensity and spatial correction with respect to current

radar echoes. The corrected NWP forecast shall then be added to SWIRLS radar projection using a weighted average approach. Weights are dynamically determined by comparing the past performance of NWP forecast and SWIRLS radar projection. This approach will help account for the rapid growth and decay of thunderstorm cells.

MMD also is in the process on implementing the Weather Research and Forecasting Model for Hurricanes (HWRF) by the National Center For Atmospheric Research (NCAR), USA.This is to improve forecast skill for track, intensity and structure of tropical cyclones in the Pacific Ocean and the South China Sea.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Mr. Muhammad Helmi Abdullah

Telephone:

Email: helmi@met.gov.my

2. Improvement of Flood Forecasting (caused by typhoon and monsoonal surges)

To date theDepartment of Irrigation and Drainage (DID) has 489 telemetry stations, 1223 manual flood gauges, 153 flood warning boards and 438 automatic flood warning sirens in flood prone areas. Several flood forecasting models have been developed to support flood forecasting tasks in DID, namely:

1. Integrated Flood Forecasting and River Monitoring System (iFFRM) for Klang Valley
2. Atmospheric Model Based Rainfall & Flood Forecasting System (AMRFF) for Pahang, Kelantan and Johor rivers
3. Integrated Flood Forecasting and Warning System for Muda river basin
4. Integrated Atmospheric and Radar-Satellite Model-Based Rainfall and Flood Forecasting for Sarawak river basin
5. Integrated Flood Forecasting and Warning System Based on Real Time Radar Rainfall for Padas river basin
6. Integrated Flood Forecasting and Warning (IFFW) System for Dungun river basin
7. Integrated Flood Forecasting and Warning System for Kerian river basin

Malaysia is committed to WMO's Working Group on Hydrology (WGH) Annual Operating Plan (AOP) 4 Development which begins in October 2014 with a preliminary site visit by Prof. Yangbo Chen. Also, the application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) and AOP 5 Extension of Xin'anjiang Model Application are in the pipeline.The second training on Xin'anjiangModel is expected to be carried out by November 2014.

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

Hydrodynamic characteristics of a river in rapidly urbanizing areas change rapidly. Thus, hydrologic models in such an area requires constant calibration. Currently, another flood forecasting model is being developed by the DID, namely the Integrated Flood Forecasting and Warning System for the Muar river basin and is expected to be completed by August 2015.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Mdm. HajjahParidahAnunbt Tahir

Telephone:

Email: paridah_a@water.gov.my

3. Enlightening the public on flood information(caused by typhoon and monsoonal surges)

Water level and flood information are disseminated to the authorities and public via mobile phone text messages, emailing and the website http://infobanjir.water.gov.my.This website has been enhanced and improved in terms of IT technology, hardware, procurement and network expansion as well as its contents to meet the requirements of technical staff in monitoring the flood situation in the country. The http://publicinfobanjir.water.gov.my website was developed and designed to be more public-friendly. Besides that, MMD also constantly holds exhibitions to educate the public on severe weather conditions and the precautions to be taken.

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

Remote areas in Malaysia that lack access to the media facilities are often caught unaware of these information. Therefore, the Government of Malaysia is working to widen the broadband coverage across the country to better disseminate these information.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Mdm. HajjahParidahAnunbt Tahir

Telephone:

Email: paridah_a@water.gov.my

4. Disaster Preparedness related to typhoons and monsoonal flooding

NIL

Identified opportunities/challenges, if any, for further development or collaboration: Lead of forecast may occasionally be late which contributes to delay in receiving the aides.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member:	Malaysia	Name of contact for this item:	Ms. RosmahwatiIshak
Telephone:		Email:	rosmahwati@jkm.gov.my

5. Disaster Managementrelated to typhoons and monsoonal flooding

NIL

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

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Ms. Rosmahwati Ishak

Telephone:

Email: rosmahwati@jkm.gov.my

6. Recovery / Restoration from disasters related to typhoons and monsoonal flooding

Identified opportunities/challenges, if any, for further development or collaboration: The success and effectiveness of disaster prevention and preparedness depends on the cooperation, understanding and capabilities of all the agencies.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Ms. Rosmahwati Ishak

Telephone:

Email: rosmahwati@jkm.gov.my

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

NIL

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia

Name of contact for this item: Mr. Alui bin Bahari

Telephone:

Email: alui@met.gov.my

7. ESCAP/WMO Typhoon Committee Attachment Training

NIL

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

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

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

Member: Malaysia Name of contact for this item: Nurul Salwa Abdul Ghani

Telephone: _____ Email: salwaag@met.gov.my

8. Expert Mission Team Visit under the ESCAP/WMO Typhoon Committee Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System (SSOP) Project

NIL

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

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology	√				√		

Hydrology	√					√	
DRR		√					
Training and research			√				√
Resource mobilization or regional collaboration				√			√

Member: Malaysia Name of contact for this item: Mr. Alui bin Bahari

Telephone: Email: alui@met.gov.my

Update of Members' Working Group representatives

i. Working Group on Meteorology

Mr. Alui bin Bahari
Deputy Director General
Malaysian Meteorological Department

Jalan Sultan
46667 Petaling Jaya
Selangor
Malaysia
Email: alui@met.gov.my

ii. Working Group on Hydrology

Mdm. HajjahParidahAnun bt Tahir
Deputy Director
Hydrology and Water Resources Division
Department of Irrigation & Drainage
Km. 7, JalanAmpang
68000 Ampang
Kuala Lumpur
Malaysia
Email: paridah_a@water.gov.my

iii. Working Group on Disaster Prevention and Preparedness

Mr. Mohd Ariff bin Baharom
Under Secretary
Disaster and Crisis Management Division
National Security Council
Aras G, Blok Barat
BangunanPerdana Putra
62502 Putrajaya
Malaysia
Email: ariff@mkn.gov.my

iv. Training and Research Coordinating Group

En. Muhammad Helmi Abdullah
Director
Research &Technical Development Division
Malaysian Meteorological Department
Jalan Sultan
46667 Petaling Jaya
Selangor
Malaysia
Email: helmi@met.gov.my

v. Resource Mobilization Group

Ms. Rosmahwati Ishak
Director
Socioeconomic Development and Financial Assistance Division
Department of Social Welfare Malaysia
Aras 9, No. 55, PersiaranPerdana
Presint 4

62100 Putrajaya
Malaysia
Email: rosmahwati@jkm.gov.my