# MEMBER REPORT

ESCAP/WMO Typhoon Committee
11th Integrated Workshop

# (Macao, China)

24 – 27 October 2014
Cebu, Philippines

# CONTENTS

## I. Overview of tropical cyclones which have affected/impacted Member's area in 2016

### 1. Meteorological Assessment (highlighting forecasting issues/impacts)

Five tropical cyclones affected Macao in the calendar year of 2016, including Tropical Depression (no name), Tropical Storm Mirinae (1603), Typhoon Nida (1604), Tropical Storm Dianmu (1608) and Typhoon Meranti (1614). The annual number of tropical cyclones was slight lower than the annual average of 6.0. (Figure 1)

**Tropical Depression (No Name)**

A tropical depression was developed over the South China Sea on 26th May. It was located about 350km south of Macao and moved north-northwestward at the speed of 20km/h, approaching the coastal area of Guangdong Province.

After the Tropical Depression made landfall near Yangjiang, Guangdong at about 5p.m. on 27th May, it changed to move in the north to northeast direction. It was located nearest to Macao at 9p.m. passing by about 110km west of Macao. As it continued to move into the inland, it weakened and dissipated in the Guangdong province finally.

| Date | Time* | Hoisted Signal |
|---|---|---|
| 26th MAY | 22:00 | No.1 |
| 28th MAY | 02:00 | All signals were lowered |

**Tropical Storm MIRINAE (1603)**

At 8 p.m. on 25 July 2016, a tropical depression was formed over the South China Sea(17.1°N, 115.1°E) and moving west-northwest at 18 km/h. At 2 p.m. on 26 July, the tropical depression intensified into a tropical storm and was named MIRINAE (1603) (18.3°N, 112.3°E).

MIRINAE was closest to Macao at 6 p.m. on 26 July, passed by the ocean at about 440km south-southwest of Macao. It made landfall at the coast of Wanning, Hainan at 10:20 p.m.. MIRINAE turned west-northwest afterwards. On 27 July, it passed through the Hainan Island, which then made landfall in northern Vietnam on 28 July and finally dissipated.

| Date | Time* | Hoisted Signal |
|---|---|---|
| 26th JULY | 10:45 | No.1 |
| 27th JULY | 02:00 | All signals were lowered |

**Typhoon NIDA (1604)**

At 8 p.m. on 29 July 2016, a tropical depression was formed in the east of the Philippines over the Pacific Ocean (12.5°N, 127.9°E) and moving northwest. This tropical depression

intensified into a tropical storm at 5 p.m. on 30 July and was named NIDA (1604) (16.2°N, 125.6°E). NIDA intensified into a severe tropical storm (17.2°N, 123.5°E) at 8 a.m. on 31 July. It was moving northwest at 20 km/h steadily and passing over northern Luzon.

NIDA entered the 800 km alert radius of Macao at 12 a.m. on 1 August and intensified into a typhoon (19.8°N, 119.3°E) at 6 a.m.. It was moving northwest at 25 km/h towards the coastal area of the Pearl River Estuary. It made landfall over the Dapeng Peninsula, Shenzhen, Guangdong Province at about 4 a.m. on 2 August and continued to move west-northwest towards inland. At 8 a.m., Typhoon NIDA was closest to Macao, about 60 km north of Macao. Finally, it dissipated in Guangxi Province.

| Date | Time* | Hoisted Signal |
|---|---|---|
| 1st AUG | 00:30 | No.1 |
| 1st AUG | 19:00 | No.3 |
| 2nd AUG | 17:30 | All signals were lowered |

**Tropical Storm DIANMU (1608)**

At 10 a.m. on 17 August 2016, a tropical depression was formed at about 160 km southwest of Macao over the northern South China Sea (21.1°N, 112.6°E). It was moving away from Macao slowly, heading west toward the Leizhou Penisula. The tropical depression intensified into a tropical storm (20.9°N, 112.1°E) at 8 a.m. on 18 August and was named DIANMU (1608) at 11 a.m. It continued to move west through the Leizhou Penisula. On 19 August, it made landfall in northern Vietnam again and finally dissipated.

| Date | Time* | Hoisted Signal |
|---|---|---|
| 17th AUGUST | 12:00 | No.1 |
| 18th AUGUST | 00:30 | No.3 |
| 18th AUGUST | 12:15 | All signals were lowered |

**Typhoon MERANTI (1614)**

At 2 p.m. on 10th September, a tropical depression intensified into a tropical storm over the Pacific Ocean to the east of Philippine (14.8°N, 138.9°E). It was named "MERANTI (1614)". METANTI was intensifying continuously during 11th September. At 8 a.m., it further intensified into a severe tropical storm (16.3°N, 135.7°E). Then it developed into a typhoon (16.7°N, 134.5°E) at 2 p.m. and moved west-northwards towards Bashi Channel.

At 8.a.m. on 14th September, MERANTI entered the 800 km alert radius of Macao and became to move northwestwards at the speed 22km/h, towards the Shantou to Xiamen area. MERANTI made landfall near Xiaman, about 550km from Macao, at about 4

a.m. on 15 September. Afterwards, it changed to move northwards in the afternoon and dissipated in Jiangxi Province finally.

| Date | Time* | Hoisted Signal |
|---|---|---|
| **14 / SEP** | **10:00** | **No.1** |
| **15 / SEP** | **07:00** | **All signals were lowered** |

*All time mentioned above is local time

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

Nil.

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

Macao was affected by five tropical cyclones in 2016, yet none of them was strong enough to merit the hoisting of typhoon signal no. 8. During the passage of Nida, according to the Fire Services Bureau, a defunct metal hut collapsed due to strong winds but no injuries were reported. In addition, a total of 38 trees fell down, with one of the fallen trees damaged an electricity cable near Patane area. Meanwhile, a combination of Typhoon Nida and high tides caused seawater to surge onto the roads in the Inner Harbour area, causing flooding and a car accident. Furthermore, Typhoon Nida also shut down ferry services and caused 125 flights to be delayed or cancelled. Passengers were stranded at the International Airport and the Outer Harbour Ferry Terminal.

| Date/Time | | Name | The Highest Signal Hoisted | Incidents (cases) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | Flooding | Landslide | Felled Trees | Billboards/ Awnings/ Windows/ Walls (Collapsed/ Tottering) | Scaffoldings/ Fencings/ Crane (Collapsed/ Tottering) | Power cables/ Lampposts (Collapsed/ Tottering) | Death / Injuries | Others |
| 26-05-16 22H00 | 28-05-16 02H00 | - | 1 | 0 | 0 | 2 | 8 | 1 | 0 | 0 | 0 |
| 26-07-16 10H45 | 27-07-16 02H00 | MIRINAE (1603) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-08-16 00H30 | 02-08-16 17H30 | NIDA (1604) | 3 | 2 | 0 | 38 | 40 | 1 | 1 | 0 | 8 |
| 17-08-16 12H00 | 18-08-16 12H15 | DIANMU (1608) | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 14-09-16 10H00 | 15-09-16 07H00 | MERANTI (1614) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 1: Damages caused by tropical cyclones in Macao during 2016**

10 rainstorm warnings were issued in 2016. The following table shows that the downpour caused minor damages to Macao.

| Date | Duration | Incidents (cases) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flooding | Felled Trees | Buildings collapsed/ Concrete spalling | Billboards collapsed or tottering | Scaffoldings collapsed or tottering | Windows collapsed or tottering | Awnings collapsed or tottering | Landslide | Deaths / Injuries | Others |
| 13-04-16 | 07H00-09H20 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 22-04-16 | 09H05-09H35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-04-16 | 12H45-14H10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10-05-16 | 08H00-09H05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20-05-16 | 20H32-21H35 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 28-05-16 | 15H22-17H45 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 11-06-16 | 03H45-06H20 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28-06-16 | 09H05-09H50 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10-07-16 | 02H08-03H50 | 11 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 09-08-16 | 13H25-14H45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 2: Damages caused by rainstorms during 2016**

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

Nil.

## II. Summary of progress in Key Result Areas

**TC Members' Report**
**Summary of Progress in KRAs**

| Item 1:<br>Improved the ability of weather forecast and nowcasting |
|---|

A brand new 3km wind profiler radar (Figure 2) was installed in order to replace old one which was broken since 2013. It strengthened the wind profile monitoring (Figure 3) capacity in Macao. Furthermore, a new radiometer (Figure 4) was also installed which is useful in the monitoring the vertical profile of temperature and water vapour (Figure 5). Both instruments can improve the monitoring of tropical cyclones and severe weather, such as rainstorm.

The imagery data derived from Himawari-8 (Figure 6) are distributed to us via an Internet cloud service and a communication satellite system known as the HimawariCast. In order to facilitate the reception of Himawari-8 data for operational meteorological services, SMG has adopted the setup of the HimawariCast receiving and processing system. Moreover, this incredible satellite technology gives us an unprecedented view of the Earth and access to local weather predications every ten minutes, which has been made available to the public via various online channels. The frequency of the weather updates is a big improvement in comparison to the previous one. This enhancement provides breathtaking clarity of imagery, compared the prior generation's satellite, as it's about four times the spatial resolution. Himawari-8 generates about 50 times more data than the previous satellite, hence our forecasters now have access to all 16 observation wavebands that capture important details from many layers of the atmosphere. It brings the conditions on the Earth to life. Our forecasters are now starting to make use of the vast quantity of new data. One of the most immediate benefits is the ability to see storms as they develop. We expect to see continual growth in our use of the data over the following years.

| Identified opportunities/challenges, if any, for further development or collaboration:<br>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 | | | | | | | |

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Item 2:
Enhanced public weather service and public education

With the strong penetration of smart phone usage among the Macao populace, a smart phone application has been developed to provide useful information to the general public. To better enhance this service we provide, upgrades of the apps have been done. Via the apps, which is freely available from the apps stores, the public is able to obtain an update to the latest weather forecast, as well as other severe weather warnings and information. More importantly, the apps also caters for push alerts to notify end users of severe weather warnings such as tropical cyclones, rainstorm, stormsurge and thunderstorms.

By means of the utilization of the "WeChat" social network, SMG has provided an account that enables the provision of the latest weather information, including weather warnings, weather forecasts, air quality forecasts, tropical cyclone information, etc. An upgrade of this service are being evaluated and will provide more useful information and alerts to the public

Upon alerts for severe weather occasions, SMG has continuously been optimizing its warning system for severe weathers, by means of strengthening the communication and coordination with relevant departments, medias and the general public by issuing pre-warning message, by the means of text, audio and video recordings. To move a step even further, we offer a dedicated webpage for the media such that they can have an immediate access to the current weather situation, especially warnings.

In order to improve the efficiency of distribution of weather warning and information to the public during the period of severe weather, SMG has been upgrading its system towards more automatic and digital. Besides upgrading the SMS system and WeChat, a new FAX Server was launched in order to improve the efficiency of message distribution.

A weather service centre was established in the Macao Ferry Terminal, aim to provide the consultation of weather information to the tourists. Moreover, display terminal was setup at the outside of the centre in order to display the real time weather information of Macao and Pearl River Delta to the tourists.

In addition, SMG has launched an objective hourly forecasts for the upcoming 48 hours, which tends to better facilitate the general public about the planning for their day, and take an hour-by-hour look at the weather for the upcoming 48 hours. At the first stage, we focus on temperature and humidity forecasts. More elements will be provided continuously. The evaluation and calibration effort is continuously ongoing.

To increase the knowledge and interest of students in meteorology, SMG will give lectures on different topics in schools every year, each topic will be prepared in two versions, one for primary schools and the other for secondary schools. Schools can choose between Chinese, Portuguese and English as their preferred language for lectures. To comply with the schools' schedule, the lectures this year covered 7 topics and were arranged from December 2015 to May 2016. Up to September, over 4100 people from 17 schools registered for the lectures, and the lectures have been ongoing in different schools.

In order to let citizens have a better understanding our operations as well as the meaning of different warnings, around 650 students and citizens were recorded visiting the SMG headquarter up to September 2016.

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 | | | | | | | |

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Item 3:
Zhuhai-Macao Cooperate to establish an integrated meteorological monitoring network in the estuary of Pearl River

Macao, China is located in the west bank of Pearl River Delta in South China. In order to reinforce the monitoring capacity on the estuary of the Pearl River during the approaching of tropical cyclone from South China Sea, Macao Meteorological and Geophysical Bureau(SMG) is cooperating with Zhuhai Meteorological Bureau of Guangdong province to establish an integrated meteorological monitoring network on the estuary of the Pearl River from 2014 to 2016. Weather station was setup in Dong'ao Island. It facilitates an automatic weather station, wind profiler, weather camera, thunderstorm detector and tide gauge. The AWS and wind profiler has already start the real time transmission of data to SMG since August this year. This new data can improve the monitoring of the weather situation during the visiting of tropical cyclones to the Region.

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 | ✔ | ✔ | | | | | |


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Item 4:
Disaster Risk Reduction

In recent years, Macao SAR Government has been committed to eliminating landslide risk. Slope Safety Working Group which is comprised of Land, Public Works and Transport Bureau (DSSOPT), Civic and Municipal Affairs Bureau (IACM) and Macau Laboratory of Civil Engineering (LECM) was set up to conduct regular inspection and survey of slopes; assess the risk level of slopes; provide recommendations on slope reinforcement and maintenance; and prepare annual assessment reports.

The following table demonstrates the distribution of slopes in Macao according to landslide risk level. Since Macao SAR Government has been exerting effort to reinforce high-risk slopes (Figure 7), the number of high-risk slopes is reduced from 4 to 2 in 2016.

| | **High Risk** | **Medium Risk** | **Low Risk** | **Total** |
|---|---|---|---|---|
| **Macao Peninsula** | 1 | 16 | 65 | 82 |
| **Taipa** | 1 | 15 | 38 | 54 |
| **Coloane** | 0 | 14 | 51 | 65 |
| **Total** | 2 | 45 | 154 | 201 |

**Table 3: Distribution of slopes in Macao according to the landslide risk level**

In addition, the Taipa Hill Slope Automatic Monitoring System which was set up by DSSOPT last year is considered effective. Through real-time monitoring on the state of the slope, related information such as cracks, displacement, groundwater, rainfall and other data will be sent to LECM in a timely manner for analysis and relevant government departments can take early preventive measures to ensure slope safety.

As for the prevention of death and serious injury from falling trees and branches, Civic and Municipal Affairs Bureau (IACM) carries out regular inspection and remove those which are deemed dangerous ahead of typhoon season (Figure 8). In 2016, over 170 dangerous trees were removed and over 2,000 trees were trimmed to protect public safety. Moreover, the

Bureau has also strengthened the control of illegal installation of business and advertising signs and removed signboards that were considered "potentially dangerous". Besides, the Bureau has appealed to the owners of commercial establishments to make sure their placards, screens and racks are placed with the necessary safety conditions.

Regarding flood prevention, DSSOPT plans to launch Taipa Hill Rainwater Interception Project which involves the construction of new stormwater drainage system to collect rainwater from the upstream part of Taipa Hill and eventually discharge to the sea. This will reduce the pressure of rainwater flowing into the Taipa City and will hence improve the flooding situation there. The project is expected to be completed by June 2017.

Furthermore, Macao Electricity Company (CEM) is also concerned about the maintenance of the electrical boxes, and nearly 50 electrical boxes have been lifted up especially those which are located in low-lying areas and flooding blackspots in order to ensure electricity supply during rainy and typhoon season (Figure 9).

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 | | | | | | | |

| | | | |
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Item 5:
Drill and Emergency Plan with Government Departments and Organizations in Preparation for Severe Weather

Macao Security Forces Coordination Office attaches great importance to the work of civil defense and will stage an annual typhoon drill every year. The drill which simulated the hoisting of typhoon signal No. 8 was hold in April this year. 27 public and private entities participated in the drill to handle 24 different cases including flooding, power outages, landslides, collapsed buildings and evacuation of victims who are affected by flooding. The purpose of the drill is to test coordination and communication among members of Civil

Protection System and strengthen interdepartmental efforts in dealing with typhoon-related incidents. The exercise went smoothly and achieved the desired results. (Figure 10)

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 | | | | | | | |

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Item 6:
Strengthened Resilience of Communities to Typhoon-related Disasters

Aside from distributing disaster prevention brochures and broadcasting video clips on television, Macao Security Forces Coordination Office in conjunction with Public Security Police Force and Fire Service Bureau to delegate representatives for the first time to Inner Harbour Area where is one of the flooding blackspots in Macao to promote public awareness on typhoon prevention (Figure 11).

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 | | | | | | | |

| | | | |
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Item 7:
Improved Capacity to Generate and Provide Accurate, Timely and understandable Information on Typhoon-related Threats.

Education and Youth Affairs Bureau (DSEJ) has been working with relevant departments to establish a coordination and notification mechanism for class suspension arrangement due to typhoon or rainstorm. If classes need to be suspended due to severe weather, the Bureau will notify parents at once through various channels including radio, television, web pages and electronic display. For cross-border school students, the Bureau will make the announcement through Zhuhai MASTV channel, radio, as well as the electronic display of the immigration building in Border Gate.

In order to facilitate the public to receive its latest information, DSEJ also launched its smartphone apps to enable citizens to timely receive information such as class suspension.

At the time of writing this report, SMG and DSEJ are revising the mechanism of communication between the departments and the distribution of message to public once again. It is scheduled that SMG will enclosed the message of class suspension in its warning if class is suspended due to the rainstorm. However, the new mechanism is still under fine tuning and has not been implemented at this moment.

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 | | | | | | | |

| | | | |
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Item 8:
Enhanced Typhoon Committee's Effectiveness and International Collaboration.

In 2016, Macao Security Forces Coordination Office delegated representatives to participate in the meetings organised by Typhoon Committee as well as TC Working Groups. These include the 48th Session of Typhoon Committee held in Hawaii, USA and the 11th Meeting of WGDRR held in Ulsan, Korea..

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 | | | | | | | |


| | | | |
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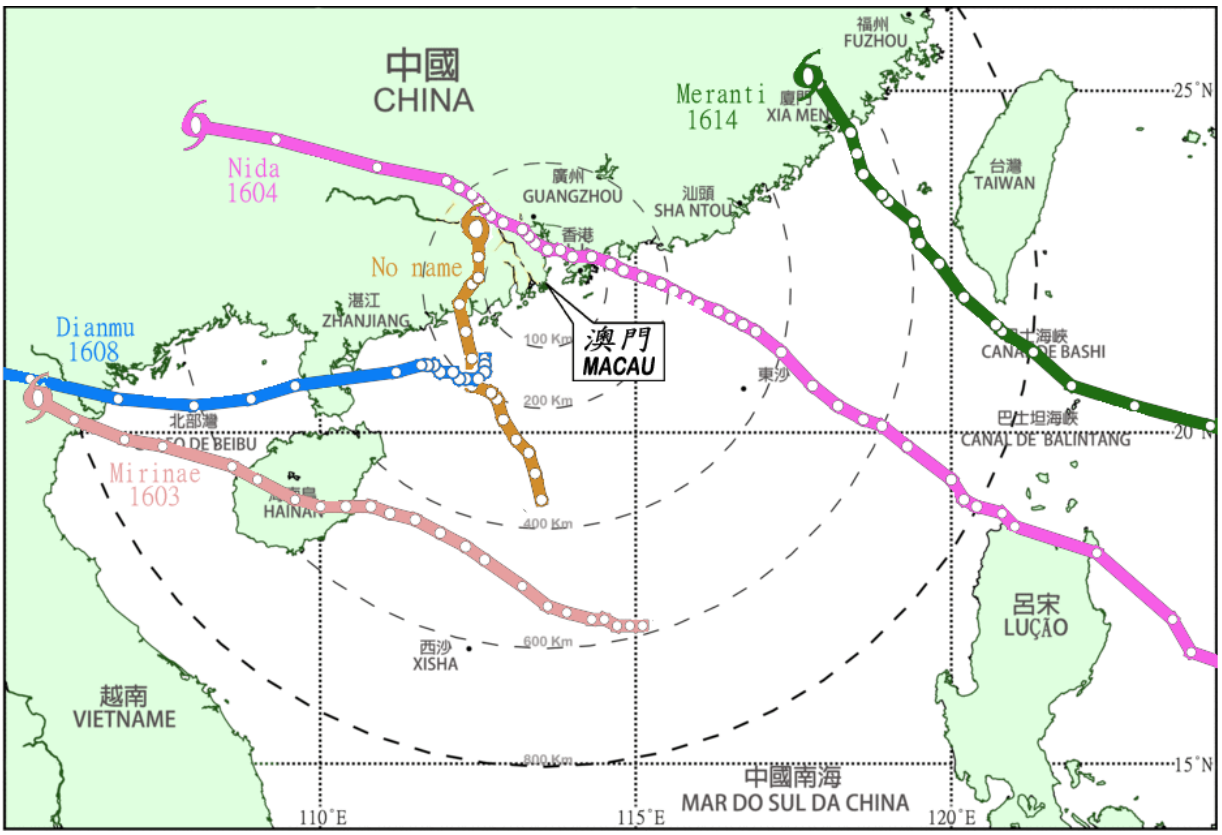

Figure 1 Tropical cyclone tracks in 2016.

Figure 2 Wind Profiler radar

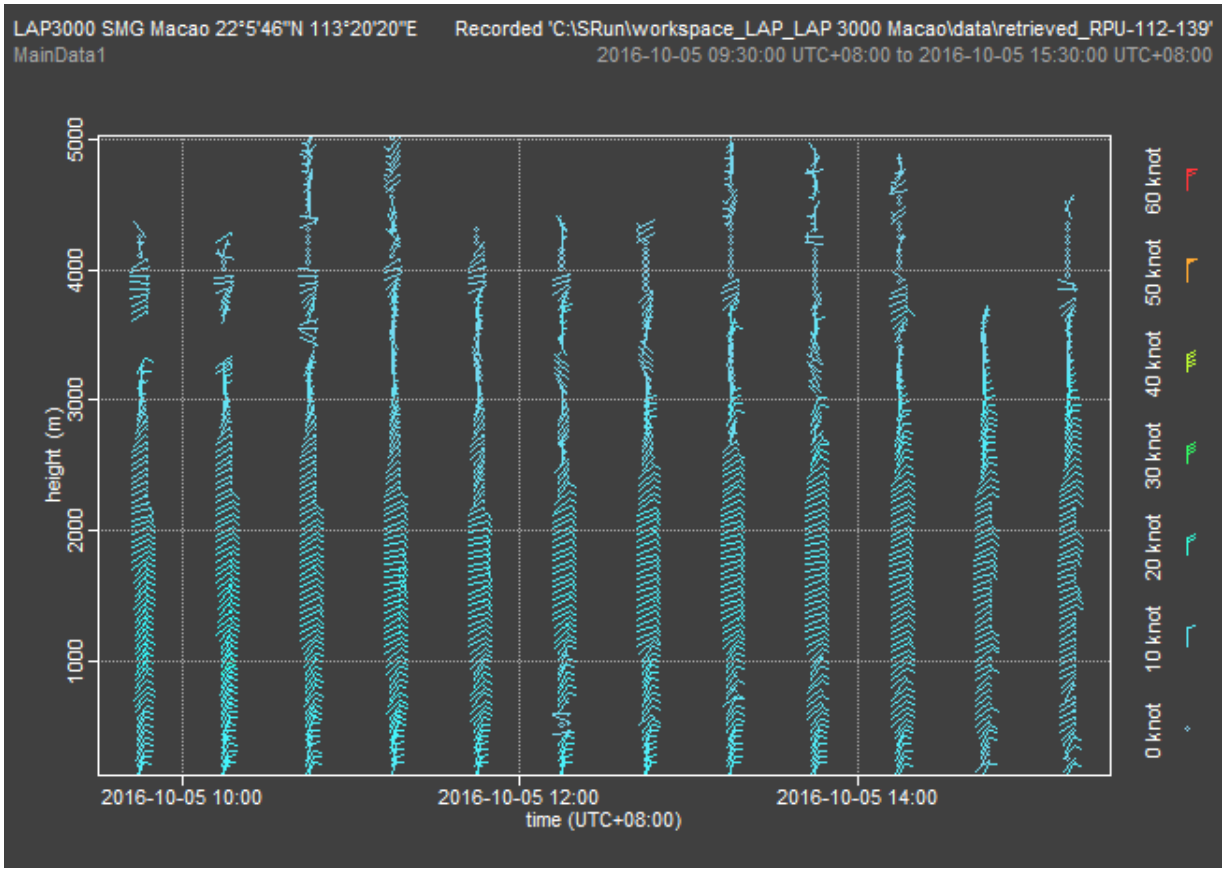

Figure 3 Products of wind profiler


Figure 4 Radiometer

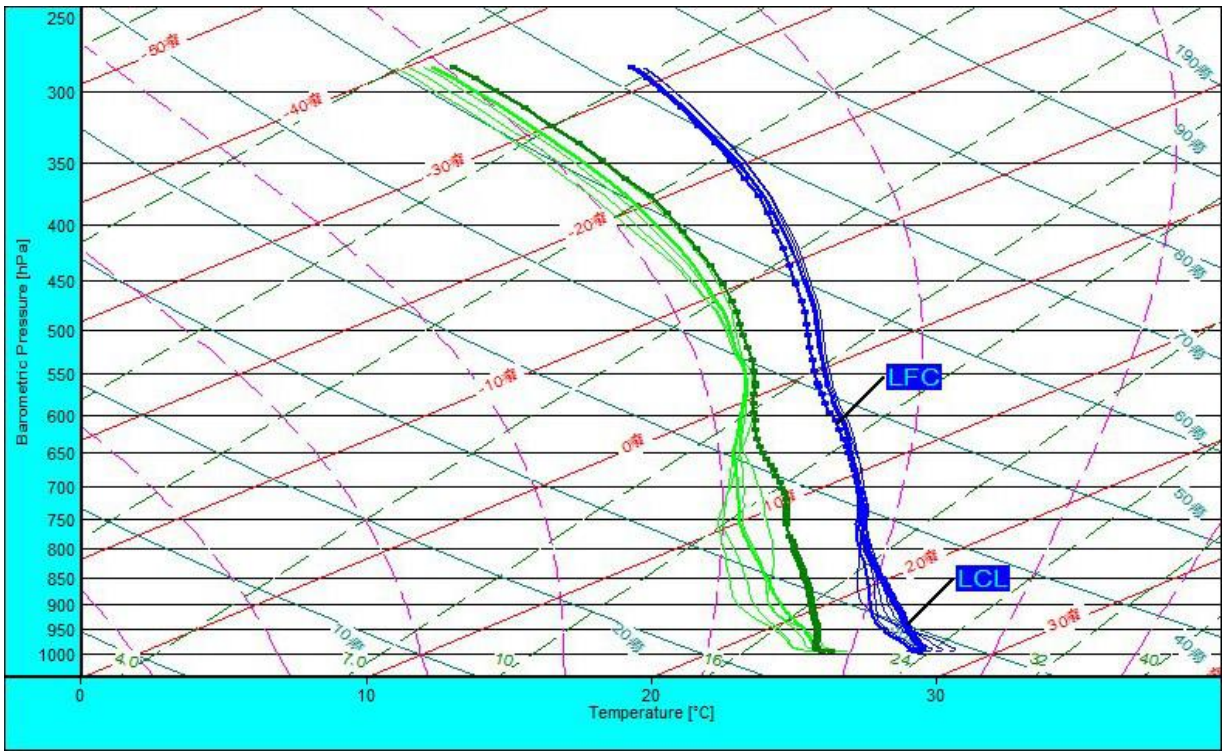

Figure 5 Products of radiometer

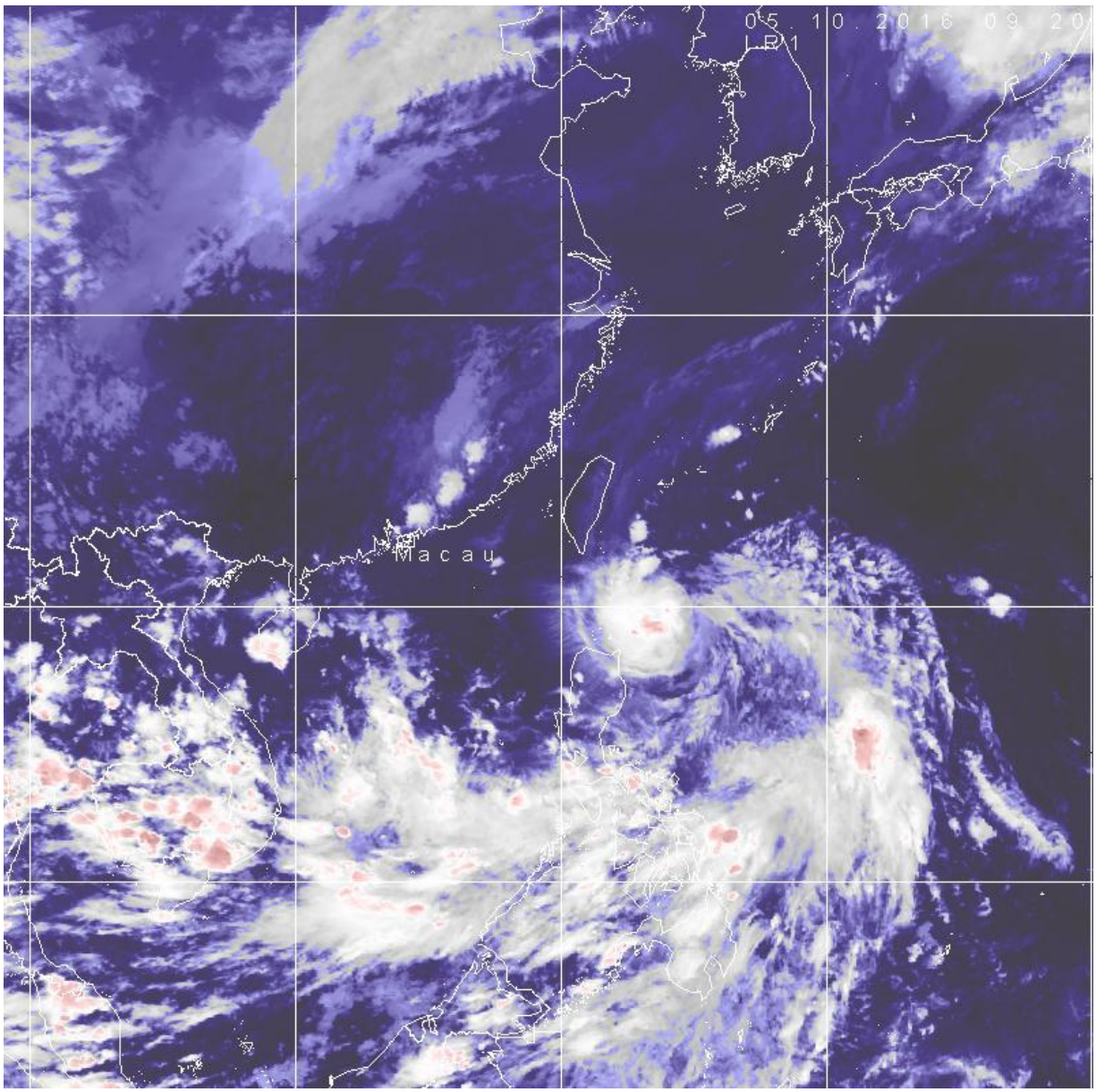

Figure 6 Himawari-8 image


Figure 7 Reinforcement and maintenance is conducted on potentially dangerous slopes.

Figure 8  IACM staffs remove trees which are deemed potentially dangerous.

Figure 9  Electricity box is lifted up especially in low-lying areas and flooding blackspots.

Figure 10 Macao Security Forces Coordination Office staged the yearly typhoon drill in April.

Figure 11 Representatives of Macao Security Forces Coordination Office, Public Security Police Force and Fire Service Bureau promote public awareness on typhoon prevention in Inner Harbour Area.