



MEMBER REPORT Macao, China

ESCAP/WMO Typhoon Committee
17th Integrated Workshop
(Video conferencing)
29-30 November 2022

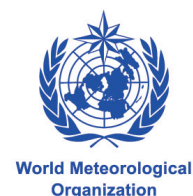
CONTENTS

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

1. Meteorological Assessment (highlighting forecasting issues/impacts)
2. Hydrological Assessment (highlighting water-related issues/impact)
3. Socio-Economic Assessment (highlighting socio-economic and DRR issues/impacts)
4. Regional Cooperation (highlighting regional cooperation and related activities)

II. Summary of Progress in Priorities supporting Key Result Areas

1. Enhanced public weather service
2. Improving forecast tools
3. Established the “Tropical Cyclone Interdepartmental Video Meeting” mechanism
4. Personnel capacity-building
5. Promotion of the knowledge of meteorology and disaster risk reduction
6. Public education and promotion among communities and schools
7. Annual emergency exercise



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

1. Meteorological Assessment (highlighting forecasting issues/impacts)

6 tropical cyclones affected Macao, China in 2022, including typhoon Chaba (2203), one tropical depression (nameless), tropical storm Mulan (2207), typhoon Ma-On (2209), typhoon Nesat (2220) and typhoon Nalgae (2222). Their tracks and the highest issued Tropical Cyclone Signals in Macao are shown in fig. 1 and table 1 respectively. Their meteorological influences on Macao are described below in details.

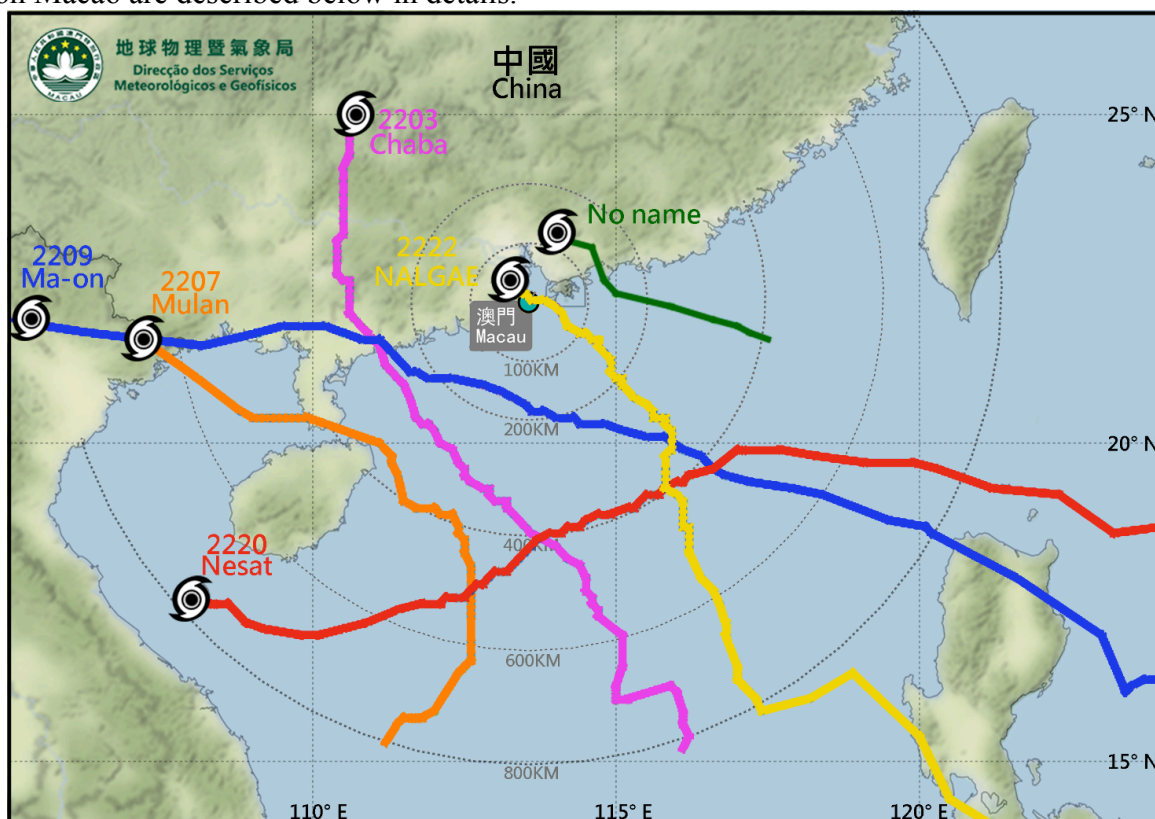


Figure 1 Tropical cyclone tracks that affected Macao, China in 2022.

Typhoon Chaba (2203)

Chaba was developed in the South China Sea on June 29th and was the first tropical cyclone affected Macao in 2022. It moved northwestwards towards western coast of Guangdong. Chaba intensified into a typhoon on July 2nd. It came closest to Macao on the July 2nd morning, about 260km to the southwest of Macao. Then made landfall near Maoming later in that afternoon and dissipated over inland Guangxi on July 3rd.

Under the influence of Chaba, wind speed up to force 10 was recorded in Macao with a maximum gust of 124km/hr. As a result, the first Tropical Cyclone Signal no.8 this year was issued. Chaba also induced a significant storm surge in Macao. Flooding occurred in low-lying areas, about 0.50m high. The yellow storm surge warning was issued. Furthermore, affected by the outer rainbands of Chaba, there are heavy showers lasted for hours in Macao. Over 100mm accumulated rainfall amount was recorded during this period.

Tropical depression “Nameless”

A broad low-pressure trough covered South China Sea at the beginning of August and there were several tropical depressions within the trough. One of them was developed into a tropical depression. It moved west-northwestwards and made landfall over the coast of Huidong on 4th morning and degenerated into a low pressure.

Since it was lack of organization, its impact on the Pearl River Delta was minimal. There were just a few showers and strong winds in Macao.

Tropical storm Mulan (2207)

Mulan was developed in South China Sea on 8th August and move northwards. It intensified into a tropical storm on 9th and turned to move in northwestwards on that night. It was closest to Macao on 10th morning, about 350km to the southwest of Macao, then later landed on north Vietnam.

Under the influence of Mulan, wind speed up to force 8 was recorded in Macao with maximum gust of 98km/hr. Mulan also induced a light storm surge in Macao. Flooding occurred in low-lying areas, about 0.12m high. The yellow storm surge warning was issued.

Typhoon Ma-On (2209)

Ma-On was developed into a tropical depression over the western North Pacific Ocean. It intensified into a typhoon and move northwestwards steadily. It entered the South China Sea on August 23rd. It came closest to Macao on the Aug 25th early morning, about 160km to the south-southwest of Macao. Finally, it landed on Guangdong west coast on 25th, then dissipated at Guangxi on 26th.

Under the influence of Ma-On, wind speed up to force 9 was recorded in Macao with maximum gust of 100km/hr. Ma-On also induced a storm surge in Macao. Flooding occurred in low-lying areas, about 0.22m high. The orange storm surge warning was issued.

Typhoon Nesat (2220)

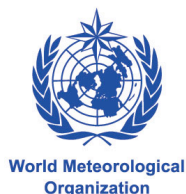
Nesat was developed into a tropical depression over the seas east to the Philippines. It intensified into a typhoon and move westwards steadily. It entered the South China Sea on Oct 16th and dissipated on Beibu Gulf on 20th.

At the same time, a cold high system was affecting China. Under the accompanied effect of its related northeast monsoon and Nesat’s circulation, winds in Macao were up to force 7 with maximum gust of 81km/hr.

Typhoon Nalgae (2222)

Nalgae was developed into a tropical depression over the western North Pacific Ocean. It intensified into a typhoon and move northwestwards steadily. It entered the South China Sea on October 30th. It came closest to Macao on the November 3rd early morning, about 10km to the east of Macao. Finally, it landed on Zhuhai on 3rd, then dissipated at Zhuhai on 3rd morning. It was the first No.8 signal issued in the month of November in 50 years since 1972, and it was the closest typhoon to Macao in 2022.

Under the influence of Nalgae, wind speed up to force 7 was recorded in Macao with maximum gust of 74km/hr. Very mild flooding occurred in low-lying areas. The blue storm surge warning was issued.



Start Date	End Date	Name	The Highest Signal
Jun 29, 2022	July 3, 2022	Chaba	No. 8
Aug 3, 2022	Aug 4, 2022	Tropical Depression	No. 1
Aug 8, 2022	Aug 11, 2022	Mulan	No. 8
Aug 23, 2022	Aug 25, 2022	Ma-On	No. 8
Oct 16, 2022	Oct 18, 2022	Nesat	No. 3
Oct 31, 2022	Nov 3, 2022	Nalgae	No. 8

Table 1 *The Tropical Cyclone Signals issued by Macao Meteorological and Geophysical Bureau during the tropical cyclones affected period.*

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

Nil.

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

In 2022, six tropical cyclones affected the Macao SAR, and four of those resulted in issue of tropical cyclones signal no 8, which are “Chuba”, “Mulan”, “Ma-on” and “Nalgae”.

From table 2, we can see that tropical cyclones “Chuba” was reported of 32 incidents, including falling trees, scaffoldings collapsed or tottered, billboards collapsed or tottered, flooding and 2 injuries were reported. Tropical cyclones “Mulan”, “Ma-on” and “Nalgae” resulted in minor damages to Macao SAR. “Mulan” was reported with 2 incidents, “Ma-on” was reported 5 incidents and no incidents were reported for “Nalgae”.

Damages caused by tropical cyclones was not significant in 2022. The Macao SAR Government has enhanced the promotion and popularization of knowledge of disaster prevention and self-protection to the public. At the same time, in confronting the tropical cyclones, effective measures have been implemented including the issue of early warning signals to the public.

The Macao SAR Government has also implemented various preventative measures in following the guidelines of COVID-19 preventions. For example, the temporary shelter needs to strictly follow the guidelines of Health Bureau, which strengthen the cleanliness/sanitation measures and to maintain social distance.

Date/Time		Name	The Highest Signal Hoisted	Incidents (cases)									
Start	End			Flooding	Landslide	Fallen Trees	Buildings collapsed/Concrete spalled off	Billboards / Awnings/ Windows/ (Collapsed / Tottered)	Scaffoldings/ Fencings/ Crane (Collapsed/ Tottered)	Power cables/ Lampposts (Collapsed/ Tottered)	Injuries	Death	Others
29/06/2022 19H00	03/07/2022 18H00	(Chuba) 2203	8	5	0	5	1	16	5	0	2	0	0
03/08/2022 23H00	04/08/2022 18H00	Tropical Depression	1	0	0	0	0	0	0	0	0	0	0
08/08/2022 19H00	11/08/2022 00H30	(mulan) 2207	8	0	0	0	1	0	0	1	0	0	0
23/08/2022 18H00	25/08/2022 18H30	(ma-on) 2209	8	0	0	1	2	2	0	0	0	0	1
16/10/2022 14H00	18/10/2022 23H00	(Nesat) 2220	3	0	0	0	2	0	0	0	0	0	0
31/10/2022 01H00	03/11/2022 08H30	(Nalgae) 2222	8	0	0	0	0	0	0	0	0	0	0

Table 2: Damages caused by tropical cyclones in Macao during 2022

As compared with 16 rainstorms (red or black level) in 2021, there were only six red or black rainstorm warning signals issued in 2022. One of the most occurred public emergencies in Macao SAR was flooding caused by rainstorm. Flooding occurs in low lying areas and sometimes landslide occurs during heavy rainstorm. In recent years, Macao SAR Government has taken

flood control and drainage improvement measures to alleviate the problem. For example, box culvert and rain water pumping station were built, educating citizens about actions to be taken during rainstorm occurs, and also broadcast rainstorm warning signals in serious situation to the public.

Incidents (cases)											
Start	End	Flooding	Fallen Trees	Buildings collapsed/ Concrete spalled off	Billboards collapsed or tottered	Scaffoldings collapsed or tottered	Windows collapsed or tottered	Awnings collapsed or tottered	Landslide	Injuries	Others
11-05-2022 11H40	11-05-2022 12H40	0	0	0	0	0	0	0	0	1	1
12-05-2022 14H40	12-05-2022 17H00	0	0	0	0	0	0	0	1	1	3
07-06-2022 03H30	07-06-2022 04H05	0	0	0	0	0	0	0	0	0	0
08-06-2022 09H15	08-06-2022 16H05	0	0	0	0	0	0	0	1	1	5
10-08-2022 01H35	10-08-2022 03H00	4	0	1	0	0	0	0	0	0	2
07-10-2022 22H40	07-10-2022 00H00	0	0	0	0	0	0	0	0	0	0

Table 3: Damages caused by rainstorms during 2022

4. Regional Cooperation (highlighting regional cooperation and related activities)

Nil.



UNITED NATIONS
Economic and Social
Commission for Asia and
the Pacific



World Meteorological
Organization

II. Summary of Progress in Priorities supporting Key Result Areas

1. Enhanced public weather service

Main text:

To enhance our service on alert messages, the message boxes on our official website were expanded last year from one to several. It allows several different types of alert messages disseminate at the same time in order to give as much essential information to the public against hazards, such as affected areas, severity, and affected period. Templates in different languages were built for various events and were always ready for duty forecasters to send out instantly.

For example, in the aspect of rainstorms, special alert messages were issued many times this year. Before issuing a rainstorm signal, the alert message was used to remind the public. It described the development of the convection and affected areas and simple advice to citizens as the following sample, "Heavy rain is currently affecting Taipa. It is going to further affect Macao over extensive areas and persist in the next 30 minutes. Please pay attention to safety and take shelter in a safe place."

In addition to rainstorm messages, tropical cyclone information was also disseminated through this kind of special alert. The messages usually include the tropical cyclone's forecast and preliminary assessment of its effect on Macao. Rather than issuing a warning, enriched special alert messages bring informative early warnings to the public. To ensure everyone can get enough time to prepare their precautions against severe weather according to everyone's own risk management.

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

Nil.

Priority Areas Addressed:

Meteorology

- Enhance the capacity to monitor and forecast typhoon activities particularly in genesis, intensity and structure change.
- Enhance and provide typhoon forecast guidance based on NWP including ensembles, weather radar and satellite related products, such as QPE/QPF.

Contact Information:

Member: Macao, China

Name of contact for this item: Mr. HO Kuok Hou

Telephone: +853 88986260

Email: khho@smg.gov.mo



2. Improving forecast tools

Main text:

Facing the impacts brought by tropical cyclones, storm surges, and rainstorms, SMG keeps increasing and improving its tools to enhance the forecast skills. A nowcasting system for precipitation was introduced this year. Its basic principle is based on the method of optical flow by using the S-band radar data of Zhu-Ao Radar. It tracks every echo cell on the radar map and extrapolates its movement in the next four hours. The accumulated rainfall amount is calculated at every single grid point in Macao, which supports us to decide whether to issue a special alert or a rainstorm warning signal. Though there is still difficulty in making quantitative precipitation forecasts precisely, the tool plays an important role to help forecasters make decisions as early as possible, to fight for more time for the public to be prepared.

SMG built a storm surge forecast model last year and keeps on putting more functions. Besides collecting tropical cyclone forecast tracks from various sources and making ideal “what-if” scenarios, we start to put all atmospheric numerical ensemble tracks, such as 52 ECMWF ensemble tracks into the model to get more reasonable storm surge results this year. By using GPU calculation, such ensemble simulations finished within a few minutes.

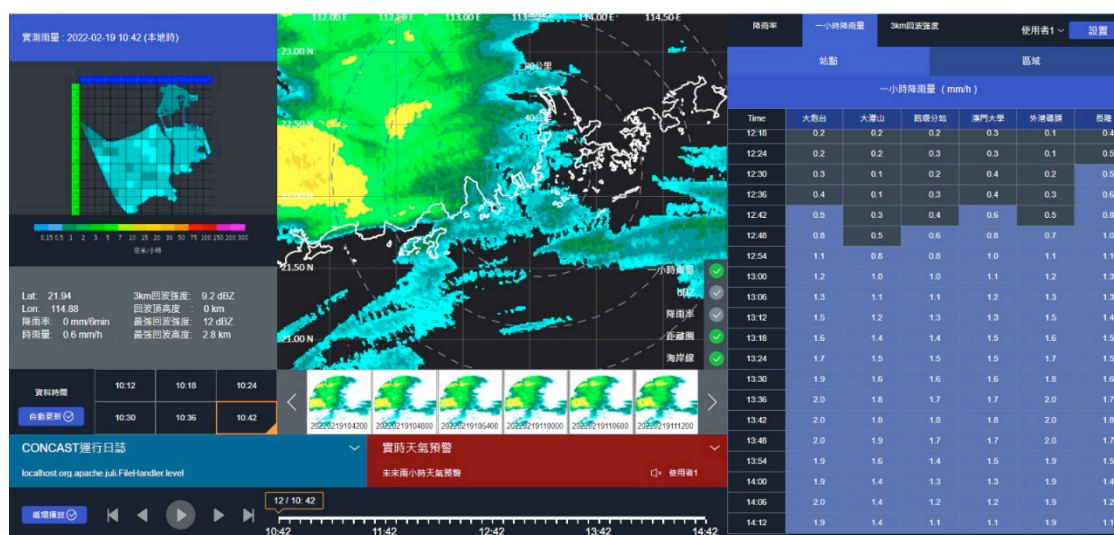


Figure 2 Screenshot of the nowcasting system. It displays the echo development and the rain rate at specific locations in Macao.

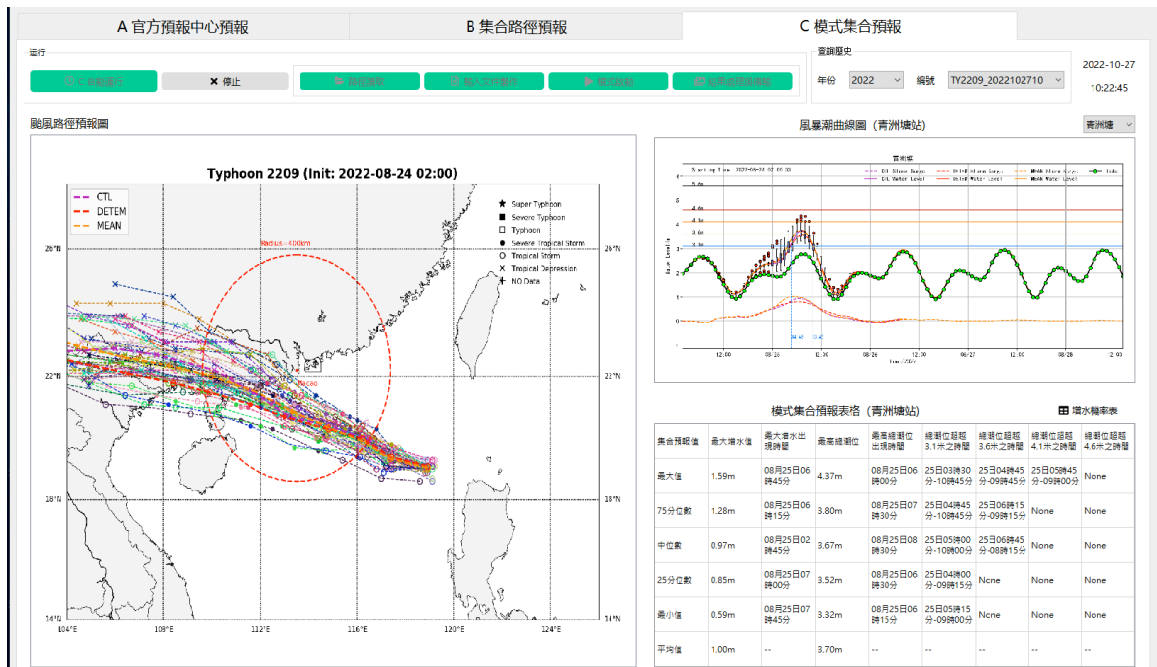


Figure 3 Screenshot of the storm surge forecast system – ensemble mode by using ECMWF ensemble tracks of tropical cyclone Ma-On.

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

Priority Areas Addressed:

Meteorology

- Enhance and provide typhoon forecast guidance based on NWP including ensembles, weather radar and satellite related products, such as QPE/QPF.

Hydrology

- Strengthen capacity in effective flood forecasting and impact-based early warning, including hazard mapping and anticipated risk based on methodological and hydrological modelling, and operation system development.

Contact Information:

Member: Macao, China
 Name of contact for this item: Mr. HO Kuok Hou
 Telephone: +853 88986260
 Email: khho@smg.gov.mo



3. Established the “Tropical Cyclone Interdepartmental Video Meeting” mechanism

Main text:

In order to help the relevant members of the Civil Protection Structure to better respond to the impact of tropical cyclones, SMG initiated and established the “Tropical Cyclone Interdepartmental Video Meeting” mechanism in 2022. Every time when a tropical cyclone is foreseen to affect Macao, SMG arranged an interdepartmental video meeting among 16 relevant member departments in the Civil Protection Structure ahead of time. During the meeting, SMG reports to the members the current situation and forecast of the tropical cyclone, and SMG also provides information regarding possible scenarios of the tropical cyclone development, possible time period and degree of impact on Macao, and also information on the risks and forecast uncertainties.

The goal of the above mechanism is to let the relevant departments obtain the latest and most accurate official information regarding the forecast and possible impact of tropical cyclones. Meanwhile, it will allow more time for the departments to make appropriate preparations in response to the development of the tropical cyclones and the associated risks. This aims to achieve the purpose of improving the efficiency of disaster risk reduction work of Civil Protection.



Figure 4 SMG holding the “Tropical Cyclone Interdepartmental Video Meeting”.

(4) 風險評估分析及總結

風力		風暴潮			降雨				
3號風球風力：17日日間至傍晚		最高潮位：約3.0米			18日至19日 約10-25mm/day				
8號風球風力：機會較低		預計水浸高度：約0.2-0.4米			發出暴雨警告機會較低				
<ul style="list-style-type: none"> 澳門風力17日增強，晚間進一步增強，最高達6~7級。 若熱帶氣旋探偏北路徑移動，澳門受影響程度增大，17日晚間至18日風力有機會達8級。 		<ul style="list-style-type: none"> 未來數日並非天文大潮，加上「納沙」直接影響澳門機會較低，發出藍色風暴潮警告機會較低。 			<ul style="list-style-type: none"> 18日至19日期間有降雨；暴雨機會較低。 				
影響	時段	17日		18日			19日		
		08-16	16-24	00-08	08-16	16-24	00-08	08-16	16-24
風力		中	大	中	大	大	中	中	小
降雨		小	小	中	中	中	中	中	中
風暴潮		小	小	較小	小	小	小	小	小

重點：
 • 18日早上最接近澳門，在東南偏南面約400公里掠過
 • 風力將會在17日增強，晚間進一步增強，最高達6~7級
 • 由於環流集中在海上，預料納沙雨帶對廣東沿岸影響程度較低

影響程度
小
較小
中
大

僅供內部參考，請勿對外發放

Figure 5 SMG presented the forecasted impact and affected time period of typhoon Nesat during the “Tropical Cyclone Interdepartmental Video Meeting”.

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

Priority Areas Addressed:

Integrated

- Strengthen the cooperation between TRCG, WGM, WGH, and WGDRR to develop impact-based forecasts, decision-support and risk-based warning.

Contact Information:

Member: Macao, China
 Name of contact for this item: Ms. CHANG Sau Wa
 Telephone: +853 88986180
 Email: swchang@smg.gov.mo



4. Personnel capacity-building

Main text:

In order to enhance the ability and knowledge of meteorological staffs, SMG staffs engaged in capacity-building activities. These include off-line lectures held by WMO RTC Nanjing for SMG personnel, on-line training courses organized by CMATC, and also workshops and seminars such as TC IWS, RSMC Tokyo Attachment Training etc.

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

Nil.

Priority Areas Addressed:

Meteorology

- Enhance training activities with TRCG, WGH, and WGD RR in accordance with Typhoon Committee forecast competency, knowledge sharing, and exchange of latest development and new techniques.

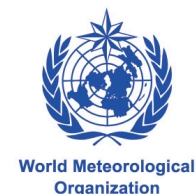
Contact Information:

Member: Macao, China

Name of contact for this item: Ms. CHANG Sau Wa

Telephone: +853 88986180

Email: swchang@smg.gov.mo



5. Promotion of the knowledge of meteorology and disaster risk reduction

Main text:

In order to promote the education of meteorological knowledge and enhance the ability of the public to respond to severe weather, SMG has been actively working to improve the popularization of science education. This includes producing educational videos, audios and infographics which are released on both traditional and new media.

In addition, SMG organized “family fun meteorology visit” activities, in which parents and children learned about severe weather through visit to the SMG, first-hand experience as a forecaster, and watching stage plays. Visits to SMG from schools and other groups are also organized.

On the other hand, SMG organized or participated in activities in cooperation with other Bureaus and Organizations. SMG and the Macao Science Center co-organized activities including 35 “weather theaters” to promote meteorology knowledge to students of different age groups in a variety of ways. SMG also participated in the civil protection knowledge promotion activities coordinated by Unitary Police Service to explain typhoon and storm surge knowledge to various communities and residents in order to enhance public awareness. SMG also participated in education activities through visits to schools, which were coordinated by Education and Youth Development Bureau, to explain rainstorm warnings and related knowledge to students in order to enhance awareness.



Figure 6 SMG organized “family fun meteorology visit” activities



Figure 7 SMG actively promotes knowledge of meteorology and natural disasters, and scientific understanding of disaster prevention

In order to enhance the knowledge in meteorology and disaster risk reduction for public and private institutions, SMG continued to invite the principals and management staff of all schools in Macao to participate in the "Severe Weather Response Exchange Meeting" in 2022. In addition, SMG continued to invite the leaders and management personnel of members of the Civil Protection system to participate in the "Tropical Cyclone and Storm Surge Exchange Meeting" to strengthen the members’ knowledge and understanding of tropical cyclone and storm surge, so as to enhance the efficiency of the work in disaster prevention and mitigation in their respective areas.



Figure 8 SMG invited the principals and management staff of all schools in Macao to participate in the "Severe Weather Response Exchange Meeting"



Figure 9 SMG invited the leaders and management personnel of members of the Civil Protection system to participate in the "Tropical Cyclone and Storm Surge Exchange Meeting"

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

Priority Areas Addressed:

Integrated

- Strengthen the cooperation between TRCG, WGM, WGH, and WGD RR to develop impact-based forecasts, decision-support and risk-based warning.

Contact Information:

Member: Macao, China

Name of contact for this item: Ms. CHANG Sau Wa

Telephone: +853 88986180

Email: swchang@smg.gov.mo

6. Public education and promotion among communities and schools

Main text:

In order to enhance the emergency response capabilities and the self-protection awareness of Macao citizens in emergency situation, Unitary Police Service committed to strengthen the education and sharing information of disaster prevention among communities and schools.

Every year before tropical cyclones season, Unitary Police Service keeps on promoting and educating the public in different low-lying areas in Macao SAR, such as holding seminars, drills and distributing leaflets about the “Storm Surge Evacuation Plan in Low-lying Areas During Typhoon” and the “Sound Siren in High Ground and Low-lying Areas for Storm Surge”, explaining the contents and precautions of the evacuation plan and familiarization of the audio alarm system. This aims to strengthen the emergency awareness and self-rescue ability of the public, improve their emergency awareness and remind them to prepare food storage, be aware of emergency information etc. before the typhoon season. Unitary Police Service hopes to work together with the citizens to minimize the impact and losses caused by typhoon.

On the other hand, Education and Youth Development Bureau, in cooperating with Unitary Police Service, prepared the “Disaster Prevention Plan for School”, “Disaster Prevention Guidelines for School” and “Safety Education Supplementary Teaching Materials”. The relevant teaching materials will be included in their syllabus, which aims to develop students’ disaster prevention knowledge and skills from an early age and hope to spread the knowledge of civil protection among their families.

Unitary Police Service and Education and Youth Development Bureau also cooperate with Macao Customs Service, Public Security Police Force, Judicial Police and Fire Services Bureau to carry out jointed disaster prevention education project for primary and secondary schools in Macao SAR, with the purpose of strengthening the students’ knowledge of different public emergency. Exercise related to preventative measures of tropical cyclone, fire prevention etc. are conducted among primary and secondary schools in Macao SAR in due course. After the exercises, conclusions will be made and opinions and advices will be provided.

In order to enhance students’ knowledge of civil protection, Unitary Police Service and Education and Youth Development Bureau organize students to visit the Civil Protection Operation Center and explain the details of the civil protection law, the concept and system of the civil protection, as well as the classification of public emergencies, etc.

Guidelines of COVID-19 have been strictly implemented during all visit sections.

We also establish the civil protection community liaison mechanism which in cooperation with 13 community societies and association, we promote and gather opinions and suggestions from the society.

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

Nil.



Priority Areas Addressed:

DRR

- Enhance Members' disaster risk reduction techniques and management strategies.

Contact Information:

Member: Macao, China

Name of contact for this item: Mr. FAN Ka Wa

Telephone: +853 82900310

Email: copc@fsm.gov.mo



UNITED NATIONS
Economic and Social
Commission for Asia and
the Pacific



World Meteorological
Organization

7. Annual emergency exercise

Main text:

The annual emergency exercise, simulating the execution of “Low-Lying Areas Evacuation Plan for Storm Surge during tropical cyclones” was held. The Evacuation Plan aims to strengthen communication and coordination among members of the civil protection structure and the efficiency of the emergency plans among different participating departments. Residents are also welcome to participate in the emergency exercise as education activity and familiarize themselves with evacuation procedures, routes and operation of emergency shelters.

Civil protection volunteers also participated the annual emergency exercise to assist in restoring normal living order for the first time. Different societies, including professional associations who deployed heavy machinery to restore accessibility of main road for restoration was also simulated via the civil protection community liaison mechanism. Meanwhile, the issue of alert signal and messages was also tested at the same time through Macao SAR Government app “Macao One Account” and WeChat mini programme of “Peaceful and Safe Macao”.

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

Nil.

Priority Areas Addressed:

DRR

- Enhance Members’ disaster risk reduction techniques and management strategies.
- Evaluate socio-economic benefits of disaster risk reduction for typhoon-related disasters.

Contact Information:

Member: Macao, China

Name of contact for this item: Mr. FAN Ka Wa

Telephone: +853 82900310

Email: copc@fsm.gov.mo

