

WORKING GROUP ON METEOROLOGY ACTIVITIES ANNUAL REPORT 2023

(Submitted by WGM Chair)

ACTION REQUIRED:

The Committee is invited to:

- a) Take note of the Members activities and major progress and issues in meteorology component in 2023 as reported by Members at the 18th IWS.
- b) Review the activities of WGM conducted in 2023.
- c) Approve the recommendations and planned activities of WGM for 2024 and beyond.

APPENDICES:

- A. DRAFT TEXT FOR INCLUSION AT SESSION REPORT
- B. Report on activities of Working Group on Meteorology (WGM) in 2023
- C. Summary Report of WGM Parallel Meeting at the 18th IWS

APPENDIX A

DRAFT TEXT FOR INCLUSION IN THE SESSION REPORT

8.1 Meteorological Component

1. The Committee took note of the Member's activities and major progress and issues in Meteorological Component in 2023 as reported by Members at the 18th IWS.
2. The Committee reviewed the activities of Members in implementing the TC Strategic Plan and its annual operating plan in relation to Meteorological Component during past year, details of which are presented in **Appendix ??**.
3. The Committee took note of the outcomes of the WGM Parallel Session at the 18th IWS on 28 November-1 December 2023. With the assistances of TCP/WMO and TCS and the strong support from all Members, WGM has successfully completed the tasks in 2023 with significant outcomes as follows:
 - a. WGM has fulfilled all the action plans (4 POPs, 10 AOPs and 2 PPs) in 2023, which were endorsed at the 55th TC Session.
 - b. The impacts of the COVID-19 pandemic since early 2020 started to diminish in 2023. Some activities in WGM such as research fellowships and technical meetings have been resumed. It is expected that WGM activities will be back to normal in 2024 with new action plans and activities.
 - c. After the 55th TC Session in 2023, WGM has been carrying out the following activities that involve the cooperation among Members as well as other TC WGs and international organizations:
 - i. Coordinated with RSMC Tokyo Typhoon Center for the online Attachment Training Course from 11 to 13 January 2023.
 - ii. Coordinated with Viet Nam Meteorological and Hydrological Administration (VNHMA) for the Roving Seminar 2023 in hybrid mode from 28 to 30 June 2023.
 - iii. Coordinated with Asia Pacific Typhoon Collaborative Research Center (AP-TCRC), China to organize the 6th WGM Annual Meeting in hybrid mode from 31 October to 2 November 2023.
 - iv. Coordinated with TRCG to host the two research fellowships hosted by the Hong Kong Observatory (HKO) and Korea Meteorological Administration (KMA), respectively.

Conclusions of WGM

Based on the information provided by Members and the respective coordinators of the operating plans, and discussions during the Parallel Meeting, the following conclusions were reached:

- a. Members have made important progress in the implementation of the TC Strategic Plan during the year 2023.
- b. Members made significant progress during 2023 in tropical cyclone monitoring and communication systems, data assimilation and numerical weather prediction systems, tropical cyclone forecast-aiding systems, and scientific understanding of tropical cyclone activities.
- c. With the help of Tropical Cyclone Programme (TCP) of WMO and Typhoon Committee Secretariat (TCS), and the absolute sincere cooperation of all Members and the effective efforts of the WGM focal points, WGM has successfully completed the tasks in 2023 as listed in Annex I of Appendix C.
- d. Based on the discussion on the operating plans for 2023 during the 18th IWS, it was concluded to adopt the operating plans as follows:
 - i. The POP items 1-4 will be continued in 2024.
 - ii. The AOP items 1-10 will be continued in 2024.
 - iii. The PP item 1 will continue and will be moved to AOP item 11 in 2024.
 - iv. The PP item 2 will continue and will be moved to AOP item 12 in 2024.
 - v. A new PP item 1 “Promoting Technical Exchange of AI Applications in Tropical Cyclone Analysis and Prediction” was proposed by HKO for 2024.
- e. The total budget proposed by WGM, which will be concurred at the AWG meeting, for undertaking the operating plans (AOPs, POPs and PPs) in 2024 is US\$39,500.
- f. The proposed WGM 2024 operating plans (AOPs, POPs and PPs) including the actions, the success indicators, coordinators and budget is listed in [Annex II of Appendix C](#).

Recommendations of WGM

- a. To request KMA to improve typhoon summer prediction techniques and share knowledge/encourage Member’s cooperation.
- b. To request CMA to encourage TC Members to use the Collaborative Discussion (CoDi) platform especially for tropical cyclones in the basin of South China Sea.
- c. To request CMA to enlarge the usage of CoDi platform for the International Training Course on Tropical Cyclone and re-examination of TC track and intensity.
- d. To request STI to publish the TCRR Journal on a quarterly basis, and to improve the editorial procedure and Journal’s influence.
- e. To request STI to issue the summary report on verification of TC forecast products in 2023 typhoon season in the western North Pacific.

- f. To request STI to strengthen international cooperation and promote the exchange of TC data and verification techniques.
- g. To request JMA to provide the current operational TC genesis guidance products using ensemble forecast.
- h. To request JMA to seek further approaches to increase the benefit of ensemble forecast utilization, including improvement of the current operational TC genesis guidance products.
- i. To request CMA to improve the performance of CMA-GD v3.2 model.
- j. To request JMA to further refine quality control techniques applied to the participants' radar networks to improve their quality of radar composites, and to implement and refine MET Malaysia and TMD's QPE calibration using rain-gauge with technical assistance of JMA.
- k. To request JMA to support applicants to join the experimental regional radar data exchange in the future, and to share the progress with the RA II/V WIGOS radar project in Southeast Asia.
- l. To request JMA to hold follow-up technical meeting(s) upon receipt of progress reports on the project Development of Regional Radar Network (AOP3) from participants.
- m. To request MET Malaysia and HKO to conduct training attachment for two participants from two TC Members on Radar Integrated Nowcasting System (RaINS) in 2024.
- n. To request JMA to add storm surge time series prediction points if requested by Members, and to publish verification results of storm surge predictions.
- o. To request JMA to encourage Members to provide complete hourly sea level data of at least one year and sea level observations during storm surge events for providing accurate astronomical tides at the stations and verification of storm surge predictions.
- p. To request CMA to conduct more scientific experiments in different scenes, and to share experiment datasets under support of the Asia-Pacific Typhoon Collaborative Research Center (AP-TCRC).
- q. To request CMA to improve forecast skills based on experimental data from EXOTICCA-II.
- r. To request JMA to improve Rapidly Developing Cumulus Area (RDCA) algorithm through the joint development with technical assistance by JMA to MET Malaysia.
- s. To request JMA to provide support for development of RDCA by MSS, TMD and VNMHA.
- t. To request JMA to hold follow-up technical meeting upon receipt of progress reports on the project Enhancing Utilization of Himawari 8/9 Products (AOP7) from participants.
- u. To request CMA to improve the tropical cyclone satellite position accuracy during nighttime and engage more sensors.
- v. To request CMA to facilitate the possibility of a specific seminar on satellite application.
- w. To request JMA to support AOP7 of WGH by providing 1-month and 3-month ensemble NWP model data, necessary for the project and available, to ICHARM.

- x. To request JMA to continue sharing knowledge and experience on awareness raising through lectures for online workshops and meetings of IFI project.
- y. To request JMA to promote awareness with hydrological authorities to both local governments and public, including the appropriate use of products.
- z. To request KMA to introduce GK2A high level products related to typhoon forecast and share the technique using GK2A data.
- aa. To request CMA to prepare for the fourth assessment report on impacts of climate change on tropical cyclones in the Typhoon Committee region.
- bb. To request KMA to enhance the monitoring of tropical cyclone development and intensification in the WNP using drifting buoys.
- cc. To request KMA to fill the missing ocean observation over the main region of tropical cyclone generation, and enhance the utilization of observed ocean data to analyze the influence of oceanic environment in tropical cyclone activities.
- dd. To endorse the proposed action plans in 2024 (including 4 POPs, 12 AOPs and 1 PP) as listed in Annex II of Appendix C – Summary Report for the WGM Parallel Meeting at the 18th IWS, which summarizes the above recommendations with additional action items.
- ee. To endorse the WGM budget request included in the budget proposal to be submitted by AWG for TC's approval.
- ff. To appoint Dr. ISHIHARA Koji as the rapporteur of TOM.
- gg. To nominate Dr. Wattana Kanbua (Thailand) to replace Dr. Vicente Malano (Philippines) as the new TC expert for ISSC of AP-TCRC.
- hh. To encourage project coordinators of all working groups to submit the outcome (research paper) to the TCRR journal.
- ii. To encourage more members to join the collaborative research of AP-TCRC and apply the funding of STCRF of AP-TCRC.

Appendix B

Report on activities of Working Group on Meteorology (WGM) in 2023

2023 ANNUAL REPORT OF WGM

(Submitted by Chair of WGM)

1. Introduction

1.1 According to the terms of reference, Working Group on Meteorology (WGM) is to promote cooperation among the Members of Typhoon Committee (TC) in the implementation of activities under the Meteorological Component of the Committee's Strategic Plan with the aim to support the socio-economic development process and enhance cooperation among the Members in all the three components. (Training and Research are incorporated as part of these three components.) Towards this end, the WGM is expected to advise and assist the Committee in:

- (a) Identifying priority issues and areas of cooperation in the Meteorological Component;
- (b) Promoting and facilitating the exchange of experiences and knowledge on latest developments and techniques related to the above issues and areas;
- (c) Coordinating and implementing priority activities and programmes of the Committee aiming at strengthening capacity of the Members in meteorology;
- (d) Mobilizing resources to carry out priority activities of the Committee related to the meteorological Component;
- (e) Reporting overall progress in the implementation of the meteorology component of the Strategic Plan;
- (f) Recommending to the Committee priority areas, programmes and activities for cooperation in meteorological research by related experts of the Members.

2. Membership

2.1 After the 55th TC Session, the composition and focal point members list of WGM are:

Chair	Dr. TANG Jie (China)
Vice Chair	Mr. Muhammed Helmi ABDULLAH (Malaysia)
Members	Ms. Phalla PEOU (Cambodia) Ms. XIANG Chunyi (China) Mr. RYU Ki Ryol (DPR Korea) Mr. K. K. HON (Hong Kong, China) Dr. ISHIHARA Koji (Japan) Mr. Bounteum SISOUPHANTHAVONG (Lao PDR) Mr. LOK Chan Wa (Macao, China) Mr. Jun GALANG (Philippines) Ms. WON Seonghee (Rep. of Korea) Mr. Lesley CHOO (Singapore) Dr. Wattana KANBUA (Thailand) Mr. Christopher BRENCHLEY (USA) Dr. Hoang Phuc LAM (Viet Nam)
Secretary of Mete.	Mr. Clarence FONG

2.2 Experts from other working groups of TC, TCP/WMO, WWRP/WMO, TCS, RSMC-Tokyo, etc. have also provided assistances to accomplish the tasks of WGM over 2023, endorsed at the 55th session of TC. The impacts of the COVID-19 pandemic since early 2020 started to diminish in 2023. Some activities in WGM such as research fellowships and technical meetings have been resumed. It is expected that WGM activities will be back to normal in 2024 with new action plans and activities.

3. The progress of WGM's plans in 2023

With the assistances of TCP/WMO and TCS and the strong support from all Members, WGM has successfully completed the action plans (4 POPs, 10 AOPs and 2 PPs) in 2023, which were endorsed at the 55th Session. The WGM activities and the progress of all action items in 2023 are reported in the **Appendix C – Summary Report of the WGM Parallel Meeting at the 18th IWS**. The complete table of the 2023 action plans and its implementation status are listed in **Annex I** of Appendix C.

After the 55th TC Session in 2023, WGM has been carrying out the following activities that involve the cooperation among Members as well as other TC WGs and international organizations:

- i. Coordinated with RSMC Tokyo Typhoon Center for the online Attachment Training Course from 11 to 13 January 2023.
- ii. Coordinated with Viet Nam Meteorological and Hydrological Administration

- (VNHMA) for the Roving Seminar 2023 in hybrid mode from 28 to 30 June 2023.
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4. Conclusions

Based on the information provided by Members and the respective coordinators of the operating plans, and discussions during the Parallel Meeting, the following conclusions were reached:

- a. Members have made important progress in the implementation of the TC Strategic Plan during the year 2023.
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5. Recommendations

- a. To request KMA to improve typhoon summer prediction techniques and share knowledge/encourage Member's cooperation.
- b. To request CMA to encourage TC Members to use the Collaborative Discussion (CoDi) platform especially for tropical cyclones in the basin of South China Sea.
- c. To request CMA to enlarge the usage of CoDi platform for the International Training Course on Tropical Cyclone and re-examination of TC track and intensity.
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- hh. To encourage project coordinators of all working groups to submit the outcome (research paper) to the TCRR journal.
- ii. To encourage more members to join the collaborative research of AP-TCRC and apply the funding of STCRF of AP-TCRC.

Appendix C

Summary Report of WGM Parallel Meeting at the 18th IWS

ESCAP/WMO Typhoon Committee

18th Integrated Workshop

28 November-1 December 2023

ESCAP Conference Center

Bangkok, Thailand

FOR PARTICIPANTS ONLY

13 November 2023

ENGLISH ONLY

WORKING GROUP ON METEOROLOGY ACTIVITIES

PROGRESS REPORT 2023

(For TC 18th IWS)

(Drafted and Submitted by WGM Chair)

ACTIONS PROPOSED:

The Committee is invited to:

- (a) Take note of the Members activities and major progress and issues in meteorology component in 2023 as reported.
- (b) Review the implementations of all WGM activities conducted in 2023.
- (c) Approve the recommendations and planned activities of WGM for 2024 and beyond.

ANNEXES:

- I. Implementation status of WGM plans in 2023
- II. Proposal plans of WGM activities in 2024
- III. Summary of the 6th WGM Annual Meeting

Progress report on the WGM in 2023
(For TC 18th IWS, 28 November-1 December 2023)

1. Background

- After the 55th TC Session, the composition and focal point members list of WGM are:

Chair	Dr. TANG Jie (China)
Vice Chair	Mr. Muhammed Helmi ABDULLAH (Malaysia)
Members	Ms. Phalla PEOU (Cambodia) Ms. XIANG Chunyi (China) Mr. RYU Ki Ryol (DPR Korea) Mr. K. K. HON (Hong Kong, China) Dr. ISHIHARA Koji (Japan) Mr. Bounteum SISOUPHANTHAVONG (Lao PDR) Mr. LOK Chan Wa (Macao, China) Mr. Jun GALANG (Phillippines) Ms. WON Seonghee (Rep. of Korea) Mr. Lesley CHOO (Singapore) Dr. Wattana KANBUA (Thailand) Mr. Christopher BRENCHLEY (USA) Dr. Hoang Phuc LAM (Viet Nam)
Secretary of Mete.	Mr. Clarence FONG

- At the 7th IWS held in Nanjing, China, WGM Chair proposed to restructure the table of Annual Operating Plans (AOPs), namely the inclusion of 2 additional tables, which are the Perennial Operating Plans (POPs) and Preliminary Projects (PPs), and the proposal was adopted by WGM. POPs refer to WGM activities that will be carried out repeatedly in following years while PPs refer to projects which preliminary studies are needed to be undertaken by WGM.
- The action plans in 2023 (including 4 POPs, 10 AOPs and 2 PPs) have been endorsed by 55th TC Session.

2. Progress of WGM operating plans (POPs, AOPs and PPs) in 2023

- The progress and the results of all the priority plans (include 4 POPs, 10 AOPs and 2 PPs) since the 55th TC Session as well as the proposed plans for 2024 submitted by the respective coordinators, which were reported as shown in

bullet 2.1 to 2.16.

- The implementation status of WGM operating plans in 2023 including the action plans and completion status; and the proposed operating plans in 2024 including success indicators and budget request are listed in [Annex I and Annex II](#) respectively.

2.1 POP1: Improve the Algorithm of Typhoon Summer Prediction (Previous name: Development of Typhoon Seasonal Prediction System)

- KMA continues to provide the products of typhoon seasonal prediction for TC Members and distribute the results to Members by email.
- The forecast is based on one statistical model (multiple linear regression model), one dynamical model (Global seasonal forecasting system – GloSea6 model) and two hybrid models (CFS and GloSea6 models).
- The forecast for 2023 was shared with WGM Members in early June, 2023. Verification from 2015 to 2023 suggests that the statistical model and CFS hybrid model have the smallest root-mean-square-error (RMSE) between 2.3 and 2.7.

2.2 POP2: Collaborative Discussion (CoDi) Forum on TC Analysis and Forecast

- Tropical Cyclone Collaborative Discussion (CoDi) Platform provides real-time exchange of information. User can communicate through online discussions and audio/video conferences. A user manual has been developed.
- The system supports both desktop and mobile devices. A reminder e-mail will be sent to user's email address if user does not check the information within 10 minutes.
- Probability products such as probability of genesis and tropical storm force winds will be shared in the future.
- Open registration for international trainees at the international training course on tropical cyclone will be provided. Re-examination of TC track and intensity will also be available.

2.3 POP3: Tropical Cyclone Research and Review

- Since its launch in February 2012, 46 issues of Tropical Cyclone Research and Review (TCRR) were published, with contributors from 20 countries and regions. Two-third of the authors are international authors, and two-third of the reviewers are international experts.
- The journal is hosted in different locations, including ScienceDirect and KeAi.

Readers spread over 126 Countries, and over 137,000 full-text downloads via ScienceDirect in 2022.

- The journal is included in the Emerging Sources Citation Index (ESCI) and received its first impact factor 2.9 in 2023. The Scopus CiteScore was 3.4.
- Two special issues (March and June 2023) were issued for IWTC-10 which was held in Bali, Indonesia in December 2022. More than 20 articles were derived from the IWTC-10 final report and 10 of them have been published in the special issues.

2.4 POP4: Verification of Tropical Cyclone Operational Forecast

- Forecast verification of 16 tropical cyclones in 2023 Western North Pacific season was performed for operational official guidances, NWP models and AI-based methods (Fengwu, Pangu, Fuxi). The AI-based methods were installed and began trial operations at Shanghai Meteorological Service since July 2023 (from TC2306 to TC2313).
- Fengwu-v2 and Pangu outperformed NCEP-GFS with 72-hour lead times and they were comparable to NCEP-GFS from 96-hour to 120-hour lead times. However, all AI-based methods had large intensity forecast error and were not comparable with NWP models.
- Verification of total precipitation for TC2305 (super typhoon DOKSURI) was performed for NWP models. The models tended to over-estimate precipitation less than 100 millimetres while under-estimating precipitation greater than 100 millimetres.

2.5 AOP1: Enhanced Use of Ensemble Forecast

- JMA continues to provide current operational products using ensemble forecast in 2023, including tropical cyclone activity prediction, track forecast with probability circle, and ensemble track.
- Based on recent improvements in forecast accuracy, the probability-circle radii of tropical cyclone track forecasts for 2 days or more have been reduced, with those for 5 days ahead being 40% smaller. The changes were applied on 26th June 2023.

2.6 AOP2: Improve the Performances and Impacts of South China Sea Typhoon Model

- The CMA-TRAMS model v3.0 now features a 9-3-1 high-resolution regional system, with different resolutions (9 km, 3 km and 1 km) producing forecasts at different intervals (6-hourly, hourly, and every 12 minutes).
- Case studies for typhoons Doksuri (2305), Khanun (2306) and Saola (2309) were carried out in 2023. The CMA-TRAMS model predicted cyclogenesis of Doksuri 132 hours ahead with more precise location and intensity than other models. It also predicted precise heavy rainfall in Fujian coast.
- The model predicted the irregular movement of Khanun very well. The track errors were smaller than ECMWF from 36-hour to 120-hour lead time.
- The model also predicted the westward movement of Saola accurately with 24 to 72-hour track errors smaller than ECMWF.
- The model has been upgraded to v3.1 and v3.2 due to limitations of the v3.0 version.

2.7 AOP3: Development of Regional Radar Network

- The Guidelines for the Participation in Experimental Regional Radar Composite Data Exchanges in Southeast Asia were developed in 2019 by BMKG, MET Malaysia, TMD and JMA. VNMHA and MSS newly participated in May 2022 and April 2023, respectively.
- Two weather radar workshops were held in Tokyo, Japan from 31 January to 3 February 2023 and 11-13 October 2023 in conjunction with the Regional WIGOS project “Capacity Building in Radar Techniques” in Region II and Region V. Participants included Indonesia, Malaysia, the Philippines, Singapore, Thailand, Viet Nam, Bangladesh, Pakistan, India, Sri Lanka and UAE.
- Following the discussion at the technical meeting in November 2021 and the weather radar workshops, the participating members agreed to proceed with data exchange support for NMHSs. The data exchange shall be aligned with the national data policy of each participating members.

2.8 AOP4: Radar Nowcasting based on RaINS/SWIRL

- The Attachment Training on RaINS in 2023 was held from 18 to 29 September 2023 at MET Malaysia with participating Members from Viet Nam and the Philippines.
- The next Attachment Training on RaINS is proposed to be held in August 2024. Tentative topics will be 1) radar QPE; 2) radar QPF integrated with NWP forecast; 3) nowcast verification and 4) satellite-derived reflectivity.

2.9 AOP5: Storm Surge Watch Scheme

- Time series charts for 78 locations in 10 Members were provided in 2023.
- Verification of storm surge prediction in 2022 was being conducted for stations where sea level observations were available in University of Hawaii Sea Level Center (UHSLC) and Global Sea Level Observing System (GLOSS) database.
- Members are encouraged to provide sea-level observations during storm surge events for verification of storm surge predictions.

2.10 AOP6: Contribution for the Experiment on Typhoon Intensity Change in Coastal Area (EXOTICCA-II)

- A set of typhoon field scheme based on surface-ocean-aero-satellite unified platform has been set up. Expect to have 1-3 experiment cases each year. Observation study based on experiment data will be carried out.
- More scientific experiments in different scenes and experiment dataset under the support of AP-TCRC to improve forecast skills such as identification for intensity and gale radius, data assimilation and physics scheme.

2.11 AOP7: Enhancing Utilization of Himawari 8/9 Products

- JMA developed a technique to identify Rapidly Developing Cumulus Areas (RDCA) using Himawari 8/9 products. An online lecture was provided to MSS, TMD and VNMHA in February 2020.
- An online technical meeting was held on 18 February 2022 to enhance NMHS utilization of observation data from the Himawari-8/9 geostationary meteorological satellites through the development of the RDCA detection techniques. Participants included MET Malaysia, MSS, TMD and VNMHA. After the meeting, the source code for RDCA detection was provided to MSS, TMD and VNMHA.
- JMA reviewed the development status of each country after providing the source code and supported them as needed.

2.12 AOP8: Parallel Analysis of Satellite Data in Operational Tropical Cyclone Monitoring

- Parallel analysis of tropical cyclone cases using Himawari-8, FY-4A and FY-4B satellites were carried out. The central cold cloud patterns were basically similar but the warmest eye temperature and minimum cold cloud radii showed differences between satellites.
- Intensive AI-Dvorak analysis was carried out to capture the fluctuation features of intensity change of landfalling tropical cyclones.
- The results of this project were shared and discussed with experts at IWTC-10 in Bali, Indonesia in December 2022.

2.13 AOP9: Enhancement of Disaster Risk Reduction against Heavy Rain in Collaboration of AOP7 of WGH

- JMA has been providing 1-month ensemble NWP model data and has arranged for providing 3-month ensemble NWP model data to ICHARM.
- Emergency warnings for heavy rain were issued for several municipalities of Fukuoka prefecture and Oita prefecture in July 2023. JMA and MLIT (Ministry of Land, Infrastructure, Transport and Tourism) held a joint press conference to alert residents to take all necessary measures to protect their lives.
- JMA advised similar cooperation of meteorological and hydrological organizations in other Member countries.

2.14 AOP10: GK2A Utilization for Tropical Cyclone

- GK2A satellite data were shared to reduce natural disasters in 2023, including rapid scan service and customized data services. The data will be serviced on NOAA's NODD (NOAA Open Data Dissemination) from December 2023. Packaged software will be released in December 2024.
- AI-based products were developed for analyzing tropical cyclone circulation, center position, intensity and size (radius of 30-knot winds). AI-based proxy radar data from GK2A/AMI in East Asia were also generated.
- A local training was held in Cambodia from 25 to 31 March 2023 on capacity building for GK-2A satellite data receiving and analysis system for forecasting and

warning of natural disasters in Cambodia.

2.15 PP1: Assessment Report on Regional Influence of Anomalous Tropical Cyclone Activity in the Western North Pacific

- Historical decadal-interdecadal change and variability of tropical cyclone activities were analyzed based on CMA tropical cyclone database.
- Regional influences related to anomalous tropical cyclone activity over western north Pacific in 2022 were revealed through comparison with historical climate mean state. Especially, influences of landfalling tropical cyclones and rainfall in China were analyzed.
- Proposed to move the PP to AOP11 in 2024 to prepare for the fourth assessment report on impacts of climate change on tropical cyclones in the Typhoon Committee region.

2.16 PP2: Tropical Cyclone Monitoring using Drifting Buoys

- KMA deployed 12 drifting buoys in 2023 to the western north Pacific. The observation data were shared to GTS to help forecast typhoons, and a monitoring webpage was developed which lists the SST and pressure values of the buoys in table and time series graphics.
- Analysis of the intensity of tropical cyclones based on data from the buoys was conducted in 2023, particularly for typhoon KOINU which was small in size but strong in intensity.
- The PP will continue and will be moved to AOP12 in 2024.

3. Conclusions and the proposed operating plans for 2024

Based on the information provided by Members and the respective coordinators of the operating plans, and discussions during the Parallel Meeting, the following conclusions were reached:

- a. Members have made important progress in the implementation of the TC Strategic Plan during the year 2023.
- b. Members made significant progress during 2023 in tropical cyclone monitoring and communication systems, data assimilation and numerical weather prediction systems, tropical cyclone forecast-aiding systems, and scientific understanding of tropical cyclone activities.
- c. With the help of Tropical Cyclone Programme (TCP) of WMO and Typhoon Committee Secretariat (TCS), and the absolute sincere cooperation of all Members and the effective efforts of the WGM focal points, WGM has successfully completed the tasks in 2023 as listed in Annex I.
- d. Based on the discussion on the operating plans for 2023 during the 18th IWS, it was concluded to adopt the operating plans as follows:
 - i. The POP items 1-4 will continue in 2024.
 - ii. The AOP items 1-10 will continue in 2024.
 - iii. The PP item 1 will continue and will be moved to AOP item 11 in 2024.
 - iv. The PP item 2 will continue and will be moved to AOP item 12 in 2024.
 - v. A new PP item 1 “Promoting Technical Exchange of AI Applications in Tropical Cyclone Analysis and Prediction” was proposed by HKO for 2024.
- e. The total budget proposed by WGM, which will be concurred at the AWG meeting, for undertaking the operating plans (AOPs, POPs and PPs) in 2024 is US\$39,500.
- f. The proposed WGM 2024 operating plans (AOPs, POPs and PPs) including the actions, the success indicators, coordinators and budget is listed in [Annex II](#).

Annex I: Status of Perennial Operating Plans (POPs), Annual Operating Plans (AOPs) and Preliminary Projects (PPs) of WGM in 2023

Status of Perennial Operating Plans (POPs) of WGM in 2023

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
KRA1 KRA2 KRA6	1	Improve the algorithm of typhoon summer prediction (Previous name: Development of typhoon seasonal prediction system)	(a) To improve typhoon summer prediction techniques (b) To share knowledge and encourage member's cooperation	(a) Provide the information of typhoon summer prediction via e-mail for member countries on late May (b) Submission of the progress report	/	KMA	/	Ms. Seonghee Won (KMA)	Continued (2021-)	Yes
KRA 6 SG 6b SG 6c	2	Collaborative Discussion (CoDi) Forum on TC Analysis and Forecast	(a) To encourage Members' typhoon forecasters to use this platform for instant or real time online discussions or information exchange (b) To run routinely.	Submission of the progress report	/	CMA, HKO, TCS	Members	Mr. Qian Chuanhai (CMA) Mr. Wong Wai-Kin (HKO) Ms. Lu Xiaoqing (CMA)	Continued (2018-)	Yes
KRA 1 - 6	3	Tropical Cyclone Research and Review	(a) To publish the journal quarterly in 2022. (b) Improvement of the editorial procedure and the journal's influence	Submission of the progress report	US\$9,000	CMA	Members	Dr. Wang Dongliang, (CMA) Mr. Fang Zheqing (CMA)	Continued (2013-)	Yes
KRA1 KRA2 KRA6 SG 6b SG 6c	4	Verification of tropical cyclone operational forecast	(a) To carry out post-season verification on the operational forecast of 2022 typhoon and report to Committee session. (b) To further improve the verification methodologies of evaluation system for typhoon forecast. (c) To offer fellowship for training on (b).	(a) Submission of the post-season verification report for TC Session (b) Progress report on the improvement of evaluation system for tropical cyclone forecast	-	CMA, HKO	Members	Mr. Chen Guomin (CMA), Mr. Wong Wai-Kin (HKO)	Continued (2015-)	Yes

Status of Annual Operating Plans (AOPs) of WGM in 2023

SP's KRA &SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
KRA 2	1	Enhanced use of ensemble forecast	(a) To continue providing the current operational products using ensemble forecast. (b) To seek further approaches to increase the benefit of ensemble forecast utilization, including improvement of the current operational products.	Submission of the progress report	/	JMA	/	Dr. ISHIHARA Koji (JMA) k- ishihara@met. kishou.go.jp	Continued (2011-)	Yes
KRA1 KRA2 KRA6	2	Improve the performances and impacts of South China Sea typhoon model	To Improve the performances and impacts of TRAMS. (a) Dynamical core: improve time-varying reference scheme, and the calculation accuracy of model's lower levels SL advection scheme. (b) Physical processes: improve convection parameterization scheme and develop a micro-physic scheme with AI learning capabilities. (c) Model products: Improve typhoon intensity forecast products and typhoon maximum wind speed products.	Submission of the assessment of performance report of model	/	CMA	Viet Nam, PAGASA, MET Malaysia	Dr. Chen Zitong (CMA)	Continued (2012-)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
KRA2 KRA5	3	Development of regional radar network	(a) To further refine quality control techniques applied to the participants' radar networks, including dual pol. radars, to improve their quality of radar composites. (b) To implement and refine MET Malaysia and TMD's QPE calibration using rain-gauge with technical assistance of JMA. (c) To support applicants to join the experimental radar data exchange in the near future, and to share the progress with the RA II/V WIGOS radar project in Southeast Asia. (d) Submission of progress reports by participants. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.	Submission of the progress report by involved Members	US\$8,000	TMD, MET Malaysia, JMA	Lao PDR, Viet Nam, Philippines	Mr. Tanya THONGNUN UI (TMD) krootan@gmail.com; Mr. Asmadi Abdul Wahab (MET Malaysia) asmadi@met.gov.my; Mr. HAGIYA Satoshi (JMA) Hagiya@met.kishou.go.jp	Continued (2011-)	Yes
KRA1 KRA2 KRA3	4	Radar nowcasting based on RaINS/SWIRL	Training for two participants from two ESCAP/WMO TC Member Countries. Topics of training are: (a) Composite radar reflectivity from multiple radars (b) Retrieve radar reflectivity from satellite data using AI. (c) Blending radar data with satellite derived radar reflectivity. (d) Nowcasting of Radar-Satellite Blend	Presentation and Submission of the progress report	US\$5,000	MET Malaysia, HKO	TBC	Mr. Hamray Muhammad Yazit (MET Malaysia), Mr. Nursalleh K Chang (MET Malaysia), Mr. Yip Weng Sang (MET Malaysia) Mr. Wong Wai Kin (HKO)	Continued (2019-)	Yes

SP's KRA &SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
			(e) Preparation of progress report							
KRA 2 KRA 3 KRA 5 KRA 7	5	Storm surge watch scheme	(a) To add storm surge time series prediction points if requested by Members. (b) To publish verification results of storm surge predictions. (c) To request Members to provide complete hourly sea level data of at least one year to provide accurate astronomical tides at the stations. (d) To request Members to provide sea level observations during storm surge events for verification of storm surge predictions.	Submission of the progress report	/	JMA	/	Dr. ISHIHARA Koji (JMA) k- ishihara@met. kishou.go.jp	Continued (2012-)	Yes
KRA1 KRA2 KRA6	6	Contribution for the Experiment on Typhoon Intensity Change in Coastal Area (EXOTICCA-II)	(a) To implement the field campaign collaboration among participating Members by using aircraft, Unmanned Surface Vessel (UAS), airship, rocket, high-resolution radar etc. (b) To collect and share the field observation and research data (c) Demonstration research on tropical cyclone intensity change in conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme).	Submission of the progress report	/	CMA, HKO	Participant Members (KMA, TMD)	Dr. TANG Jie (STI) Mr. WONG Wai-Kin (HKO) Dr. LEI Xiaotu (CMA)	Continued (2014-)	Yes
KRA 2 KRA 5	7	Enhancing Utilization of Himawari 8/9 Products	(a) To improve RDCA algorithm through the joint development with technical assistance by JMA to MET Malaysia. (b) To provide supports for development of RDCA by MSS, TMD and VNMHA. (c) Submission of progress reports by the participants.	Submission of the progress report.	US\$9,000	JMA	MET Malaysia, MSS, TMD, VNMHA	Mr. HAGIYA Satoshi (JMA) Hagiya@met. kishou.go.jp; Mr. Asmadi Abdul Wahab (MET Malaysia) asmadi@met.g ov.my; Mr. Lim Yi	Continued (2018-)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
			Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.					Xiang (MSS) lim_yi_xiang@nea.gov.sg; Mr. Tanya THONGNUN UI (TMD) krootan@gmail.com; Mr. Nguyen Vinh Thu (VNMHA) vinhthu73@gmail.com		
	8	Parallel analysis of satellite data in operational tropical cyclone monitoring (Available data used in operational tropical cyclone analysis)	(a) To hold a specific seminar on this project. (b) To analysis TCs with AI-Dvorak based on parallel satellite data (c) To submit a summary.	Submission of the progress report	US\$7,000	CMA	Members interested in this project	Ms. XIANG Chunyi (CMA)	Continued	Yes
KRA 1 KRA 2 KRA 3 KRA 4 KRA 5	9	Enhancement of disaster risk reduction against heavy rain in collaboration of a new AOP of WGH	To support AOP7 of WGH through (a) Providing 1-month and 3-month ensemble NWP model data, necessary for the project and available, to ICHARM. (b) Continuing sharing knowledge and experience on awareness raising through lectures for online workshops and meetings of IFI project. (c) Promoting awareness with hydrological authorities to both local governments and public, including the appropriate use of products.	Submission of the progress report	/	JMA	Philippines	Dr. ISHIHARA Koji (JMA) k-ishihara@met.kishou.go.jp	Continued (2019-)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
KRA1 KRA4	10	GK2A Utilization for Tropical Cyclone	(a) Introduce GK2A upper level products related typhoon forecast and share the technique using GK2A data (b) Submit progress reports. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.	Submission of the progress report	-	KMA	-	Dr. Jinho Shin (KMA)	Continued (2021-)	Yes

Status of Preliminary Projects (PPs) of WGM in 2023

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks	Status of Completion
	1	Assessment Report on Regional Influence of Anomalous Tropical Cyclone Activity in the Western North Pacific (WNP)	(a) Review research on decadal-interdecadal change and variability of tropical cyclone activities. (b) Assess a possible way to observe decadal-interdecadal changes and variability in the recent 5-10 years. (c) Enhance scientific understanding of the regional influences related to anomalous tropical cyclone (TC) activity in WNP. (d) Enhance public/stakeholders' knowledge on the status of scientific understanding and	Submission of the progress report	-	CMA	Scientists and forecasters from Members	Dr. Xin Huang(CMA)	New and will support by AP-TCRC and STCRF	Yes

			<p>its limitation on regional influences and their long-term variability due to anomalous TCs.</p> <p>(e) Promote research collaboration with the Members to assess and understand decadal-interdecadal variability of TC activities and their influences in the Member's regions.</p> <p>(f) Submit progress reports annually to timely inform the progress of research on anomalous climate states of WNP TC activities and influences.</p>							
	2	Tropical Cyclone Monitoring using Drifting Buoys	<p>(a) Enhance the monitoring of tropical cyclone development and intensification in the western North Pacific (WNP) using drifting buoys</p> <p>(b) Fill in the missing ocean observation over the main region of TC generation and contribute to the decision-making process for tropical cyclone forecasting in real-time</p> <p>(c) Produce the observed ocean data (Pressure, SST) and share with TC members the data in real-time</p> <p>(d) Promote the inter-national cooperation with TC members to drop buoys on the wider area and produce</p>	Submission of the progress report	-	KMA	Members interested in this project	Ms. Seonghee Won (KMA)	New	Yes

			<div>more sufficient ocean data</div> <div>(e) Enhance the utilization of observed ocean data to analyze the influence of oceanic environment in TC activities and improve the prediction skill of TC intensi-fication</div>							
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Annex II: Proposal for Perennial Operating Plans (POPs), Annual Operating Plans (AOPs) and Preliminary Projects (PPs) of WGM in 2024

Status of Perennial Operating Plans (POPs) of WGM in 2024

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
KRA1 KRA2 KRA6	1	Improve the algorithm of typhoon summer prediction (Previous name: Development of typhoon seasonal prediction system)	(a) To improve typhoon summer prediction techniques (b) To share knowledge and encourage member's cooperation	(a) Provide the information of typhoon summer prediction via e-mail for member countries on late May (b) Submission of the progress report	/	KMA	/	Ms. Seonghee Won (KMA)	Continued (2021-)
KRA 6 SG 6b SG 6c	2	Collaborative Discussion (CoDi) Forum on TC Analysis and Forecast	(a) To encourage Members' typhoon forecasters to use this platform for instant or real time online discussions or information exchange (b) To run routinely.	Submission of the progress report	/	CMA, HKO, TCS	Members	Mr. Qian Chuanhai (CMA) Mr. Wong Wai-Kin (HKO) Ms. Lu Xiaoqing (CMA)	Continued (2018-)
KRA 1 - 6	3	Tropical Cyclone Research and Review	(a) To publish the journal quarterly in 2022. (b) Improvement of the editorial procedure and the journal's influence	Submission of the progress report	US\$9,000	CMA	Members	Dr. Wang Dongliang (CMA) Mr. Fang Zheqing (CMA)	Continued (2013-)
KRA1 KRA2 KRA6 SG 6b SG 6c	4	Verification of tropical cyclone operational forecast	(a) To carry out post-season verification on the operational forecast of 2022 typhoon and report to Committee session. (b) To further improve the verification methodologies of evaluation system for typhoon forecast. (c) To offer fellowship for training on (b).	(a) Submission of the post-season verification report for TC Session (b) Progress report on the improvement of evaluation system for tropical cyclone forecast	-	CMA, HKO	Members	Mr. Chen Guomin (CMA), Mr. Wong Wai-Kin (HKO)	Continued (2015-)

Proposal for Annual Operating Plans (AOPs) of WGM in 2024

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
KRA 2	1	Enhanced use of ensemble forecast	(a) To continue providing the current operational products using ensemble forecast. (b) To seek further approaches to increase the benefit of ensemble forecast utilization, including improvement of the current operational products.	Submission of the progress report	/	JMA	/	Dr. ISHIHARA Koji (JMA) k-ishihara@met.kishou.go.jp	Continued (2011-)
KRA1 KRA2 KRA6	2	Improve the performances and impacts of South China Sea typhoon model	To Improve the performances and impacts of TRAMS. (a) Dynamical core: improve time-varying reference scheme, and the calculation accuracy of model's lower levels SL advection scheme. (b) Physical processes: improve convection parameterization scheme and develop a micro-physics scheme with AI learning capabilities. (c) Model products: Improve typhoon intensity forecast products and typhoon maximum wind speed products.	Submission of the assessment of performance report of model	/	CMA	Viet Nam, PAGASA, MET Malaysia	Dr. Chen Zitong (CMA)	Continued (2012-)
KRA2 KRA5	3	Development of regional radar network	(a) To further refine quality control techniques applied to the participants' radar networks, including dual pol. radars, to improve their quality of radar composites. (b) To implement and refine MET Malaysia and TMD's	Submission of the progress report by involved Members	US\$8,000	TMD, MET Malaysia, JMA	Lao PDR, Viet Nam, Philippines	Mr. Tanya THONGNUNU I (TMD) krootan@gmail.com; Mr. Asmadi Abdul Wahab (MET Malaysia)	Continued (2011-)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
			<p>QPE calibration using rain-gauge with technical assistance of JMA.</p> <p>(c) To support applicants to join the experimental radar data exchange in the near future, and to share the progress with the RA II/V WIGOS radar project in Southeast Asia.</p> <p>(d) Submission of progress reports by participants. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.</p>					asmadi@met.gov.my; Mr. HAGIYA Satoshi (JMA) hagiya@met.kishou.go.jp	
KRA1 KRA2 KRA3	4	Radar nowcasting based on RaINS/SWIRL	<p>Training for two participants from two ESCAP/WMO TC Member Countries. Topics of training are:</p> <p>(a) Composite radar reflectivity from multiple radars</p> <p>(b) Retrieve radar reflectivity from satellite data using AI.</p> <p>(c) Blending radar data with satellite derived radar reflectivity.</p> <p>(d) Nowcasting of Radar-Satellite Blend</p> <p>(e) Preparation of progress report</p>	Presentation and Submission of the progress report	US\$5,000	MET Malaysia, HKO	TBC	Mr. Hamray Muhammad Yazit (MET Malaysia), Mr. Nursalleh K Chang (MET Malaysia), Mr. Yip Weng Sang (MET Malaysia) Mr. Wong Wai Kin (HKO)	Continued (2019-)
KRA 2 KRA 3 KRA 5 KRA 7	5	Storm surge watch scheme	<p>(a) To add storm surge time series prediction points if requested by Members.</p> <p>(b) To publish verification results of storm surge predictions.</p> <p>(c) To request Members to provide complete hourly sea level data of at least one year to provide</p>	Submission of the progress report	/	JMA	/	Dr. ISHIHARA Koji (JMA) k-ishihara@met.kishou.go.jp	Continued (2012-)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
			accurate astronomical tides at the stations. (d) To request Members to provide sea level observations during storm surge events for verification of storm surge predictions.						
KRA1 KRA2 KRA6	6	Contribution for the Experiment on Typhoon Intensity Change in Coastal Area (EXOTICCA-II)	(a) To implement the field campaign collaboration among participating Members by using aircraft, Unmanned Surface Vessel (UAS), airship, rocket, high-resolution radar etc. (b) To collect and share the field observation and research data (c) Demonstration research on tropical cyclone intensity change in conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme).	Submission of the progress report	/	CMA, HKO	Participant Members (KMA, TMD)	Dr. TANG Jie (STI) Mr. WONG Wai-Kin (HKO) Dr. LEI Xiaotu (CMA)	Continued (2014-)
KRA 2 KRA 5	7	Enhancing Utilization of Himawari 8/9 Products	(a) To improve RDCA algorithm through the joint development with technical assistance by JMA to MET Malaysia. (b) To provide supports for development of RDCA by MSS, TMD and VNMHA. (c) Submission of progress reports by the participants. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.	Submission of the progress report.	US\$9,000	JMA	MET Malaysia, MSS, TMD, VNMHA	Mr. HAGIYA Satoshi (JMA) Hagiya@met.kishou.go.jp; Mr. Asmadi Abdul Wahab (MET Malaysia) asmadi@met.gov.my; Mr. Lim Yi Xiang (MSS) lim_yi_xiang@nea.gov.sg; Mr. Tanya THONGNUNU I (TMD) krootan@gmail.com; Mr. Nguyen Vinh Thu (VNMHA) vinhthu73@gmail.com	Continued (2018-)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
	8	Parallel analysis of satellite data in operational tropical cyclone monitoring (Available data used in operational tropical cyclone analysis)	(a) To hold a specific seminar on this project. (b) To analysis TCs with AI-Dvorak based on parallel satellite data (c) To submit a summary.	Submission of the progress report	US\$7,000	CMA	Members interested in this project	Ms. XIANG Chunyi (CMA)	Continued
KRA 1 KRA 2 KRA 3 KRA 4 KRA 5	9	Enhancement of disaster risk reduction against heavy rain in collaboration of a new AOP of WGH	To support AOP7 of WGH through (a) Providing 1-month and 3-month ensemble NWP model data, necessary for the project and available, to ICHARM. (b) Continuing sharing knowledge and experience on awareness raising through lectures for online workshops and meetings of IFI project. (c) Promoting awareness with hydrological authorities to both local governments and public, including the appropriate use of products.	Submission of the progress report	/	JMA	Philippines	Dr. ISHIHARA Koji (JMA) k-ishihara@met.kishou.go.jp	Continued (2019-)
KRA1 KRA4	10	GK2A Utilization for Tropical Cyclone	(a) Introduce GK2A upper level products related typhoon forecast and share the technique using GK2A data (b) Submit progress reports. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.	Submission of the progress report	-	KMA	-	Dr. Jinho Shin (KMA)	Continued (2021-)
	11	Assessment Report on Regional Influence of Anomalous Tropical Cyclone Activity in the Western North	(a) Review latest climate research on typhoons activity and related regional influence since finalization of the third assessment report.	Submission of the progress report	-	CMA	Scientists and forecasters from Members	Dr. Xin Huang(CMA) huangx@typhoon.org.cn	Moved from PP1 in 2023 and Continued

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
		Pacific (WNP)	(b) Enhance scientific understanding of the impact of climate change on typhoon activities and related regional influence. (c) Promote research collaboration with the Typhoon Committee Members to assess and understand the impact of climate change on typhoons from history to future. (d) Develop the fourth assessment report and prepare to contribute to the seventh IPCC assessment cycle.						
	12	Tropical Cyclone Monitoring using Drifting Buoys	(a) Enhance the monitoring of tropical cyclone development and intensification in the western North Pacific (WNP) using drifting buoys (b) Fill in the missing ocean observation over the main region of TC generation and contribute to the decision-making process for tropical cyclone forecasting in real-time (c) Produce the observed ocean data (Pressure, SST) and share with TC members the data in real-time (d) Promote the inter-national cooperation with TC members to drop buoys on the wider	Submission of the progress report	-	KMA	Members interested in this project	Ms. Seonghee Won (KMA)	Moved from PP2 in 2023 and Continued

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
			<p>area and produce more sufficient ocean data</p> <p>(e) Enhance the utilization of observed ocean data to analyze the influence of oceanic environment in TC activities and improve the prediction skill of TC intensification</p>						

Proposal for Preliminary Projects (PPs) of WGM in 2024

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator (please add email address)	Remarks
	1	Promoting Technical Exchange of AI Applications in Tropical Cyclone Analysis and Prediction	Organize a “kick-start” workshop to further discuss the pilot project and articulate Members’ needs	<p>Workshop successfully held by end of 2024</p> <p>Reviewed latest capabilities and activities of AI</p> <p>Articulated user requirements from Members, and understood shortcomings and gaps in current capabilities</p>	Host Member in-kind contribution – to support one person from each Member that has more urgent need in capacity-building in AI (e.g. air fare and	HKO	<p>Representatives of interested TC Members</p> <p>Representatives of leading AI development teams</p> <p>Chairs of WGs - TCS</p>	Mr. K. K.Hon (kkhon@hko.gov.hk)	New

				<p>Proposed recommendations to WGM in promoting and facilitating AI applications</p>	<p>accommodation)</p> <p>TCTF support (USD 1,500 for 2-3 TCS staff participation)</p> <p>AI development teams – self-funding</p>					
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Report of the 6th Annual Meeting of Working Group on Meteorology (WGM)

I. Organization of the Meeting

1. The 6th Annual Meeting of Working Group on Meteorology (WGM) was hosted by AP-TCRC from 31 October to 2 November 2023 in Shanghai, China. The Meeting was held in hybrid mode.
2. Members from China; Hong Kong, China; Japan; Lao PDR; Macao, China; Malaysia; Philippines; Republic of Korea; Thailand; USA; Viet Nam; Typhoon Committee Secretariat (TCS) and World Meteorological Organization (WMO) participated in the Meeting. The agenda and participant list can be found in Annex I and II, respectively.
3. The opening speech was delivered by Mr. ZENG Qin, Director General, Department of International Cooperation, CMA and Mr. FENG Lei, Director General, Shanghai Meteorological Service, CMA. Dr. DUAN Yihong, Secretary of Typhoon Committee and Mr. YU Yun, Regional Office of WMO also gave the opening remarks.
4. The Meeting was moderated by Dr. Tang Jie, Chairperson of WGM and Mr. Clarence Fong, Meteorologist of TCS. The main purpose of the Meeting was to review the progress of the annual priority plans of WGM in 2023, and to discuss the implementation plans in 2024.

II. Technical Presentations and Member's Reports

5. Four technical presentations focusing the topic “New techniques – Challenge and Opportunities of Typhoon Early Warning for All” were presented by three speakers, namely Dr. Wattana KANBUA from Thai Meteorological Department, Dr. ZHANG Han from Ministry of Natural Resources, China and Mr. SUN Ziyao from Shanghai Typhoon Institute, China.
6. The participating Members presented their Member's Reports in 2023. This was not included in previous years due to COVID-19 with time constraints in online meetings.

III. WGM Annual Priority Plans in 2023 and Implementation Plans for 2024

7. In 2023, WGM has 16 annual priority plans (including 4 POPs, 10 AOPs and 2 PPs). Project coordinators or their representatives reviewed the progress in the Meeting.
8. The Members also discussed the implementation plans for 2024. All POPs, AOPs and PPs will continue in 2024, with the 2 PPs upgraded to AOPs respectively. There will be 4 POPs and 12 AOPs in 2024.
9. A new PP titled “Promoting Technical Exchange of AI Applications in Tropical Cyclone Analysis & Prediction” was proposed by Hong Kong, China. Details of the PP will be given in the WGM parallel meeting during the 18th IWS.

10. The budget requirement for all priority plans was discussed in the Meeting and remained the same in 2024, with a total of USD39,500.
11. Details of the progress and plans for the annual priority plans are included in the WGM progress report to be submitted at 18th IWS.

IV. Other Business

12. Mr. YU Jun from WMO presented “An Introduction to Early Warnings for All” to give Members some ideas about the WMO Early Warning for All (EW4All) initiative.
13. A discussion on the “AOP Evaluation Questionnaire” was held. Dr. DUAN Yihong from TCS noticed the word “evaluation” might be too strong for some Members as the questionnaires mainly served as data analysis purpose. He encouraged Members to complete and return the questionnaires to TCS before the deadline.

V. Closing of Meeting

14. Being no other business, the Meeting was closed at 5:00 pm on 1 November 2023. A farewell dinner was held in Yu Garden together with a tour to the Bund.
15. A technical visit to AP-TCRC and Shanghai Planetarium in Lin-gang Special Area was arranged in the morning of 2 November 2023.

The 6th Annual Meeting of TC Working Group on Meteorology

31 October - 2 November 2023 (GMT+8)

Hybrid Meeting hosted by

AP-TCRC, Shanghai, China

Co-sponsored by

Chinese Academy of Meteorological Sciences

Shanghai Typhoon Institute, China Meteorological Administration

Shanghai Meteorological Society

AGENDA

Date	Time	List	Remarks
Day 1 Oct. 31 Tue.	09:00-09:30	Registration	
	09:30-10:00	Opening Remarks 1. Mr. ZENG Qin , Director General, Department of International Cooperation of CMA 2. Mr. FENG Lei , Director General, Shanghai Meteorological Service, CMA 3. Dr. DUAN Yihong , TC Secretary 4. Mr. YU Jun , Regional Officer, WMO	Moderator: Dr. TANG Jie Chairperson of WGM
	10:00-10:15	Participants introduction	
	10:15-10:45	Photos Session and Coffee Break	
	10:45-12:30	Technical presentations (New techniques—Challenge and Opportunity of Typhoon Early Warnings for All) 1. Dr. Wattana KANBUA , 3D Virtual Typhoon Synthesis for Proactive Warning System Using Virtual Cloud3D 2. Dr. Wattana KANBUA , 3D Virtual Flood Simulation for Proactive Community Preparation 3. Dr. ZHANG Han , Cooperative Observation of Oceanic Moored and Mobile Instruments during Tropical Cyclones 4. Mr. SUN Ziyao , Typhoon wind radii analysis based on multi-source spaceborne microwave sensor observations	25 min for each including Q&A
	12:30-14:00	Lunch Time	
	14:00-17:20	Country Report (20 min. break time at 15:30): Cambodia; China; DPR Korea; Hong Kong, China; Japan; Laos; Macao, China; Malaysia; Philippines; RO Korea; Singapore; Thailand; USA; and Vietnam	(15 min. For each including Q/A)
	18:00	Welcome Dinner	
Day 2 Nov. 1 Wed.	9:00-11:20	POP/AOP/PPs Presentations (20min. break at 10:30)	(10 min. For each including Q/A)
	11:20-12:30	AOP Evaluation Questionnaire Discussion	70 min.
	12:30-14:00	Lunch Time	
	14:00-17:30	Review of WGM 2023 Budget and Discussion for WGM 2024 Plans and Budget(20 min. break time at 15:30)	

		Mr. YU Jun , An introduction on Early Warnings for All	
		Open Discussion	
	18:30	Dinner	
Day 3 Nov. 2 Thu.	8:00-10:00	Drive to Lin-gang Special Area	AP-TCRC
	10:00-12:00	Technical visit	
	12:00-12:30	Close session	
	12:30-13:30	Lunch Time	

The 6th Annual Meeting of TC Working Group on Meteorology
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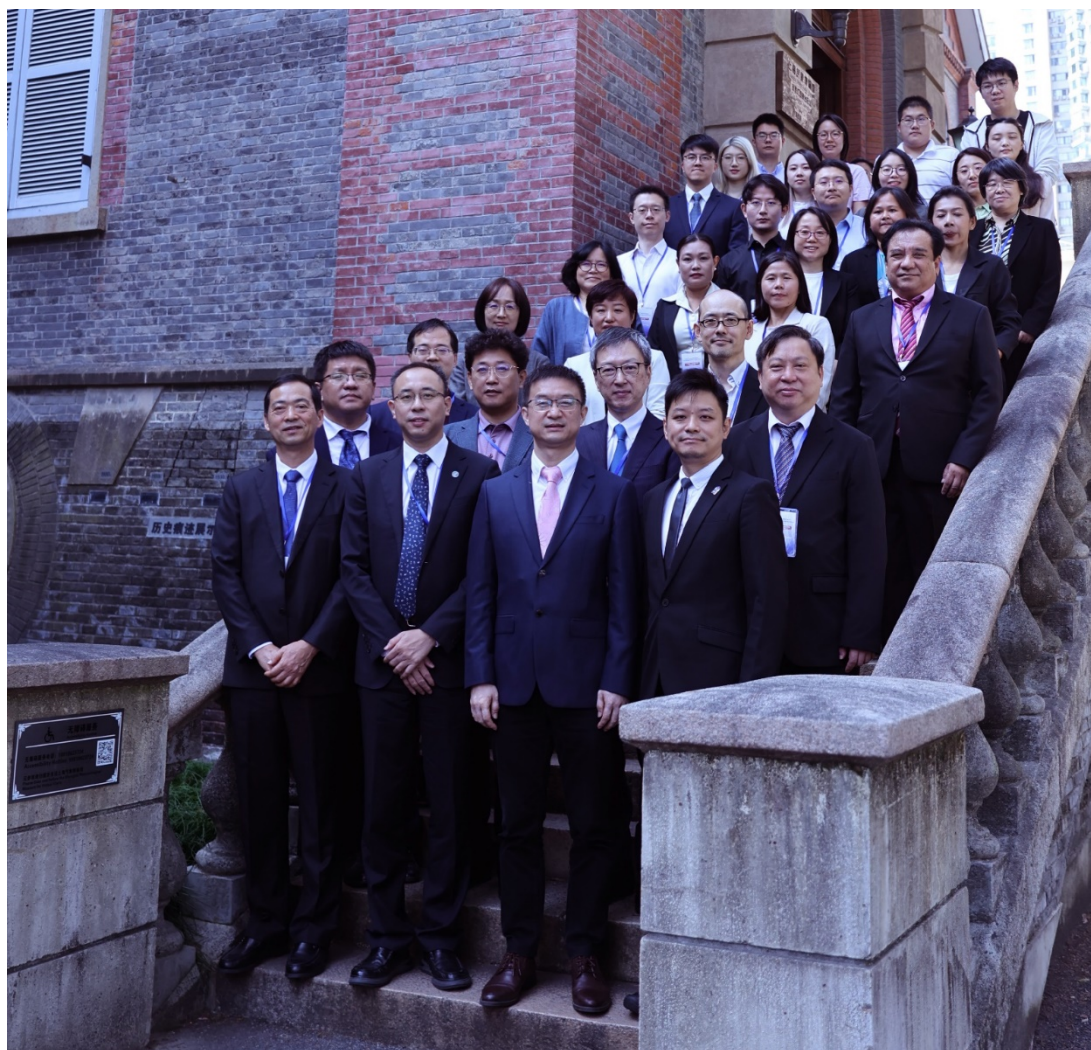
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Group photo of participants taken at the Shanghai Meteorological Museum in Shanghai, China on 31 October 2023.