

ESCAP/WMO Typhoon Committee
Fifty-second Session
25-28 February 2020
Hong Kong, China

FOR PARTICIPANTS ONLY
WRD/TC52/9.1
21 January 2020

ENGLISH ONLY

**WORKING GROUP ON METEOROLOGY ACTIVITIES
ANNUAL REPORT 2019**

(submitted by WGM Chair)

ACTION PROPOSED:

The Committee is invited to:

- (a) Take note of the Members activities and major progress and issues in meteorology component in 2019 as reported by Members at the 14th IWS.
- (b) Review the activities of WGM conducted in 2019.
- (c) Approve the recommendations and planned activities of WGM for 2020 and beyond.

APPENDICES:

- I. DRAFT TEXT FOR INCLUSION AT SESSION REPORT
- II. Report on activities of Working Group on Meteorology (WGM) in 2019
- III. Summary Report of WGM Parallel Meeting at the 14th IWS

APPENDIX I

DRAFT TEXT FOR INCLUSION IN THE SESSION REPORT

9.1 Meteorological Component

1. The Committee took note of the Member's activities and major progress and issues in Meteorological Component in 2019 as reported by Members at the 14th 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 II**.
3. The Committee took note of the outcomes of the WGM Parallel Session at the 14th IWS on 4-7 November 2019 (**Appendix III**). With the assistances of TCP/WMO and TCS and the strong support from all Members, WGM has successfully completed the tasks in 2019 with significant outcomes as follows:
 - a. WGM has fulfilled all the action plans (5 POPs, 8 AOPs and 2 PPs) in 2019, which were endorsed at the 51st TC Session.
 - b. After the 51st TC Session in 2019, WGM has been carrying out many activities that involve the cooperation among Members as well as other TC WGs and international organizations, which include:
 - i. Coordinated with the Japan Meteorological Agency (JMA) to organize the second WGM Annual Meeting in Tokyo, Japan from 7 to 9 October 2019.
 - ii. Coordinated with Korea Meteorological Administration (KMA) for holding a technology transfer of Typhoon Operation System (TOS) to Macao, China from 16 to 17 October 2019.
 - iii. Coordinated with JMA for holding a technical meeting on regional radar network from 13 to 15 November 2019 with participants from Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam.
 - iv. Coordinated with China Meteorological Administration (CMA) for the International Training Course on Typhoon Monitoring and Forecast from 11 to 21 November 2019. 28 trainees from China, Hong Kong, China, Thailand, Viet Nam, Bangladesh, Myanmar, Maldives, and Sri Lanka attended the training.
 - v. Coordinated with JMA for the RSMC Tokyo Attachment Training from 18 to 29 November 2019 with nine forecasters from Bangladesh,

China, Hong Kong, China, Lao P.D.R., Macao, China, Malaysia, Myanmar, Thailand and Viet Nam.

- vi. Coordinated with TRCG to host the 2019 research fellowships which include the following:
 - The National Typhoon Center (NTC) of KMA provided a training and research programme on Typhoon Operation System (TOS) and analysis of satellite and radar data from 20 May to 14 June 2019. Two forecasters from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), National Center for Hydro-Meteorological Forecasting (NCHMF) of Vietnam participated in this program.
 - A scientist from USA, Prof. Kimberly Wood of the Mississippi State University, visited the Shanghai Typhoon Institute (STI) of CMA as the visiting editor of the journal, Tropical Cyclone Research and Review (TCRR), on 24-29 March 2019.
 - The Hong Kong Observatory (HKO) offered the fellowship on a topic entitled “Integrated Precipitation Estimator using Radar and Satellite (IPERS) for Tropical Cyclone Rainfall (TC) Analysis and Nowcasting” in 2019. A forecaster from the Philippines will participate in the fellowship. Tentatively, the fellowship will be conducted in the first quarter of 2020.

Conclusions of WGM

In the basis of the information provided by Members and the respective coordinator of the actions plan and based on the discussion during the 14th IWS, the following conclusions were reached:

- a. Members have made important progress in the implementation of the TC Strategic Plan during the year 2019.
- b. Members made significant progress during 2019 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 2019.
- d. Experts from other working groups of TC, TCP/WMO, TCS, RSMC-Tokyo, etc. have also provided assistances to accomplish the tasks of WGM over 2019,

- namely the two WMO demonstration projects (TLFDP and TCEFP), visiting editor to TCRR editorial office (Shanghai) and research fellowships.
- e. The 2nd WGM Annual Meeting was held in Tokyo, Japan from 7 to 9 October 2019 (**Annex III of Appendix III**). Major results of the meeting were reported during the WGM parallel session in the 14th IWS.
 - f. Based on the discussion on the action plans for 2020 during the 14th IWS, it was concluded to adopt the action plans as follows:
 - i. The POP item 1-5 and AOP item 1-3, 5-8 will be continued in 2020.
 - ii. The AOP item 4 will be closed.
 - iii. The PP1 item will be continued and moved as the AOP4 in 2020.
 - iv. The PP2 item will be continued and moved as the AOP9 in 2020.
 - v. Establish one new PP item related to the workshop on typhoon forecasting techniques and WGM project progress review, as the cross-cutting project between WGM and TRCG, in 2020.
 - g. The total budget proposed by WGM, which has been concurred at the AWG meeting during the 14th IWS, for undertaking the actions plans (AOPs, POPs and PPs) in 2020 is US\$44,000. In addition, the budget of US\$12,000 will be allocated for a new cross-cutting project (PP1) between WGM and TRCG.
 - h. The complete WGM 2020 action plans (AOPs, POPs and PPs) including the actions, the success indicators, coordinators and budget are listed in **Annex II of Appendix III**.

Recommendations of WGM

- a. To request KMA to continue provide seasonal typhoon outlook information for TC Members with verification of summer and fall outlook and performance of the four statistical and dynamical models.
- b. To request CMA to encourage TC Members to join the Collaborative Discussion (CoDi) Forum for real-time typhoon discussion and information exchange.
- c. To request STI to publish the TCRR Journal on a quarterly basis in 2020, and to improve the editorial procedure and Journal's influence.
- d. To request KMA to continue provide technology transfer of the TOS for interested Members, and to package the modules for transfer in steps.
- e. To request STI to continue the evaluation of performance of tropical cyclone forecast in western North Pacific in 2020, and to continue the development of the new TC forecast and verification website.
- f. To request JMA to further develop tropical cyclone genesis guidance using early Dvorak Analysis (EDA) and global ensemble.
- g. To request CMA to continue improving the TRAMS-V3.0 (Tropical Region Atmospheric Model System) including model techniques, 4dvar data

assimilation and typhoon ensemble forecasting.

- h. 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 Malaysian Meteorological Department (MMD) and Thailand Meteorological Department (TMD)'s QPE calibration using rain-gauges.
- i. To request JMA to support applicants to join the experimental regional radar data exchange in the future, and to share the progress with RA II/V WIGOS radar project in Southeast Asia.
- j. To request JMA to compose a user's guide on QPE among JMA, MMD and TMD.
- k. To request JMA to hold follow-up meeting upon receipt of progress report on the project (AOP3) from participants.
- l. To request JMA to add storm surge time series prediction upon request from Members.
- m. To request JMA to publish verification results of storm surge predictions.
- n. 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 improving the prediction and verification.
- o. To request JMA to work on the upgrade of the storm surge model to use finite volume method (FVM) with an unstructured (triangular) grid, in which the grid resolution only around coastal regions will be increased and resources for calculation are largely saved.
- p. To request JMA to work on expanding the storm surge model domain as well as increasing the number of multi-scenario prediction using whole members of Ensemble Prediction System (EPS).
- q. To request STI and HKO to continue field campaigns with new instruments, and to collect and share the field observation and research data.
- r. To request STI and HKO to continue demonstration research on tropical cyclone intensity change in conjunction with WMO/WWRP and its relevant projects.
- s. To request JMA to improve Rapidly Developing Cumulus Area (RDCA) algorithm through the joint development by JMA and MMD, and to provide supports for development of RDCA by Meteorological Service Singapore (MSS), TMD and Viet Nam Meteorological and Hydrological Administration (VNMHA).
- t. To request JMA to hold follow-up meeting(s) upon receipt of progress report on the project (AOP7) from participants.
- u. To request CMA to enlarge more Standard Dvorak Technique fixes back to 5 years and to include more agencies into parallel analysis.
- v. To request CMA to organize a seminar with experts from CMA, JMA, KMA and HKO to facilitate better understanding of satellite sources and identify challenges in narrowing the gaps between analysis by different authorities.

- w. To request MMD and HKO to composite radar reflectivity from multiple radars, to retrieve radar reflectivity from satellite data using AI, and to blend the data to perform nowcasting.
- x. To request JMA to support AOP7 of WGH through providing NWP model data necessary for the project and available to International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM), and through continuing sharing knowledge and experience on awareness raising to governments including the appropriate use of products.
 - y. To request TCS send “Commendation letter” to the expert team of TC-AR3.
 - z. To encourage coordinators of the action plans to submit the outcome (research paper) to TCRR.
 - aa. To endorse the proposed action plans in 2020 (including 5 POPs, 9 AOPs and 1 PP) as listed in **Annex II of Appendix III – Summary Report for the WGM Parallel Meeting at the 14th IWS**, which summarizes the above recommendations with additional action items.
 - bb. To endorse the WGM budget request included in the budget proposal to be submitted by AWG for TC’s approval.

Appendix II
Report on activities of Working Group on Meteorology (WGM)
of TC in 2019

2019 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 51st TC Session, the composition and focal point members list of WGM are:

Chair	Dr. Lei Xiaotu (China)
Vice Chair	Dr. Vicente B. Malano (Philippines) Mr. Alui Bahari (Malaysia)
Members	Ms. Peou Phalla (Cambodia) Mr. Ryu Ki Ryol (DPR Korea) Mr. C.M. Cheng (Hong Kong, China) Dr. EITO Hisaki (Japan) Mr. Vanhdy Douangmala (Lao PDR) Mr. Wong Chan Seng (Macao, China) Mr. Renito B. Paciente (Philippines) Dr. Cha Eun Jeong (Rep. of Korea) Ms. Patricia Ee (Singapore) Mr. Surapong Sapara (Thailand) Mr. Christopher Brenchley (USA) Mr. Vo Van Hoa (Viet Nam)
TCS Meteorologist	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 2019, endorsed at the 51st session of TC. These include RSMC Tokyo attachment training and technical meetings for regional radar network and radar nowcasting based on RAINS, research fellowships offered by CMA, HKO and KMA, visiting editors to TCRR editorial office and second WGM Annual Meeting in JMA.

3. The progress of WGM's plans in 2019

With the assistances of TCP/WMO and TCS and the strong support from all Members, WGM has successfully completed the action plans (5 POPs, 8 AOPs and 2 PPs) in 2019, which were endorsed at the 51st Session. The WGM activities and the progress of all action items in 2019 are reported in the **Appendix III – Summary Report of the WGM Parallel Meeting at the 14th IWS**. The complete table of the 2019 action plans and its implementation status are listed in **Annex I** of the Summary Report.

After the 51st TC Session in 2019, WGM has been carrying out many activities that involve the cooperation among Members as well as other TC WGs and international organizations, which include:

- i. Coordinated with the Japan Meteorological Agency (JMA) to organize the second WGM Annual Meeting in Tokyo, Japan from 7 to 9 October 2019.
- ii. Coordinated with Korea Meteorological Administration (KMA) for holding a technology transfer of Typhoon Operation System (TOS) to Macao, China from 16 to 17 October 2019.
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- v. Coordinated with JMA for the RSMC Tokyo Attachment Training from 18 to 29 November 2019 with nine forecasters from Bangladesh, China, Hong Kong, China, Lao P.D.R., Macao, China, Malaysia, Myanmar, Thailand and Viet Nam.
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4. Conclusions

- a. Members have made important progress in the implementation of the TC

- Strategic Plan during the year 2019.
- b. Members made significant progress during 2019 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 2019.
 - d. Experts from other working groups of TC, WMO/TCP, TCS, RSMC-Tokyo, etc. have also provided assistances to accomplish the tasks of WGM over 2019, namely the two WMO demonstration projects (TLFDP and TCEFP), visiting editor to TCRR editorial office (Shanghai) and research fellowships.
 - e. The 2nd WGM Annual Meeting was held in Tokyo, Japan from 7 to 9 October 2019 (**Annex III of Appendix III**). Major results of the meeting were reported during the WGM parallel session in the 14th IWS.
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 - h. The complete WGM 2020 action plans (AOPs, POPs and PPs) including the actions, the success indicators, coordinators and budget are listed in **Annex II of Appendix III**.

5. Recommendations

- a. To request KMA to continue provide seasonal typhoon outlook information for TC Members with verification of summer and fall outlook and performance of the four statistical and dynamical models.
- b. To request CMA to encourage TC Members to join the Collaborative Discussion (CoDi) Forum for real-time typhoon discussion and information exchange.
- c. To request STI to publish the TCRR Journal on a quarterly basis in 2020, and to

- improve the editorial procedure and Journal's influence.
- d. To request KMA to continue provide technology transfer of the TOS for interested Members, and to package the modules for transfer in steps.
 - e. To request STI to continue the evaluation of performance of tropical cyclone forecast in western North Pacific in 2020, and to continue the development of the new TC forecast and verification website.
 - f. To request JMA to further develop tropical cyclone genesis guidance using early Dvorak Analysis (EDA) and global ensemble.
 - g. To request CMA to continue improving the TRAMS-V3.0 (Tropical Region Atmospheric Model System) including model techniques, 4dvar data assimilation and typhoon ensemble forecasting.
 - h. 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 Malaysian Meteorological Department (MMD) and Thailand Meteorological Department (TMD)'s QPE calibration using rain-gauges.
 - i. To request JMA to support applicants to join the experimental regional radar data exchange in the future, and to share the progress with RA II/V WIGOS radar project in Southeast Asia.
 - j. To request JMA to compose a user's guide on QPE among JMA, MMD and TMD.
 - k. To request JMA to hold follow-up meeting upon receipt of progress report on the project (AOP3) from participants.
 - l. To request JMA to add storm surge time series prediction upon request from Members.
 - m. To request JMA to publish verification results of storm surge predictions.
 - n. 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 improving the prediction and verification.
 - o. To request JMA to work on the upgrade of the storm surge model to use finite volume method (FVM) with an unstructured (triangular) grid, in which the grid resolution only around coastal regions will be increased and resources for calculation are largely saved.
 - p. To request JMA to work on expanding the storm surge model domain, as well as increasing the number of multi-scenario prediction using whole members of Ensemble Prediction System (EPS).
 - q. To request STI and HKO to continue field campaigns with new instruments, and to collect and share the field observation and research data.
 - r. To request STI and HKO to continue demonstration research on tropical cyclone intensity change in conjunction with WMO/WWRP projects.
 - s. To request JMA to improve RDCA algorithm through the joint development by

- JMA and MMD, and to provide supports for development of RDCA by MSS, TMD and VNMHA.
- t. To request JMA to hold follow-up meeting(s) upon receipt of progress report **on the project (AOP7)** from participants.
 - u. To request CMA to enlarge more Standard Dvorak Technique fixes back to 5 years and to include more agencies into parallel analysis.
 - v. To request CMA to organize a seminar with experts from CMA, JMA, KMA and HKO to facilitate better understanding of satellite sources and identify challenges in narrowing the gaps between analysis by different authorities.
 - w. To request MMD and HKO to composite radar reflectivity from multiple radars, to retrieve radar reflectivity from satellite data using AI, and to blend the data to perform nowcasting.
 - x. To request JMA to support AOP7 of WGH through providing NWP model data necessary for the project and available to ICHARM, and through continuing sharing knowledge and experience on awareness raising to governments including the appropriate use of products.
 - y. To request TCS send “Commendation letter” to the expert team of TC-AR3.
 - z. To encourage coordinators of the action plans to submit the outcome (research paper) to TCRR.
 - aa. To endorse the proposed action plans in 2020 (including 5 POPs, 9 AOPs and 1 PP) as listed in **Annex II of Appendix III – Summary Report for the WGM Parallel Meeting at the 14th IWS**, which summarizes the above recommendations with additional action items.
 - bb. To endorse the WGM budget request included in the budget proposal to be submitted by AWG for TC’s approval.

APPENDIX III
SUMMARY REPORT OF WGM PARALLEL MEETING AT THE 14TH IWS

ESCAP/WMO Typhoon Committee
14th Integrated Workshop
4-7 November 2019
Guam, USA

FOR PARTICIPANTS ONLY
7 November 2019
ENGLISH ONLY

WORKING GROUP ON METEOROLOGY ACTIVITIES
PROGRESS REPORT 2019

(For TC 14th IWS)

(Submitted by WGM Chair)

ACTION PROPOSED:

The Committee is invited to:

- (a) Take note of the Members activities and major progress and issues in meteorology component in 2019 as reported.
- (b) Review the implementations of all WGM' activities conducted in 2019.
- (c) Approve the recommendations and planned activities of WGM for 2020 and beyond.

ANNEXS:

- I. Implementation status of WGM plans in 2019
- II. Proposal plans of WGM activities in 2020
- III. Summary of the 2nd WGM Annual Meeting

Progress report on the WGM in 2019
(For TC 14th IWS, Guam, USA 4-7 November 2019)

1. Background

- After the 51st TC Session, the composition and focal point members list of WGM are:

Chair	Dr. Lei Xiaotu (China)
Vice Chair	Dr. Vicente B. Malano (Philippines) Mr. Alui Bahari (Malaysia)
Members	Ms. Phalla Peou (Cambodia) Mr. Ryu Ki Ryol (DPR Korea) Dr. C.M. Cheng (Hong Kong, China) Dr. EITO Hisaki (Japan) Mr. Vanhdy Douangmala (Lao PDR) Mr. Wong Chan Seng (Macao, China) Mr. Renito B. Paciente (Philippines) Dr. Cha Eun Jeong (Rep. of Korea) Ms. Patricia Ee (Singapore) Mr. Surapong Sarapa (Thailand) Mr. Christopher Brenchley (USA) Mr. Vo Van Hoa (Viet Nam)
Secretary of Mete.	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 was adopted by WGM. POPs are referring to the WGM activities that will be carried out repeatedly in the following years while the PPs referring to the projects of which preliminary studies needed to be undertaken by WGM.
- The action plans in 2019 (including 5 POPs, 8 AOPs and 2 PPs) have been endorsed by 51st TC Session.

2. Progress of WGM action plans (POPs, AOPs and PPs) in 2019

- The progress and the results of all the priority plans (include 5 POPs, 8 AOPs and 2 PPs) since the 51st TC Session as well as the action plans in 2019

submitted by the respective coordinators, which were reported as shown in bullet 2.1 to 2.15.

- The Implementation status of WGM Action plans in 2019 including the actions and the completion status; and the action plans in 2020 are listed in [Annex I](#) and [Annex II](#) respectively.

2.1 POP1: Development of typhoon seasonal prediction system

- KMA continues to provide the products of typhoon seasonal prediction for TC Members.
- Summer and fall outlooks of typhoon seasonal activities are available with 4 different statistical and dynamical models.

2.2 POP2: Collaborative Discussion (CoDi) forum on TC analysis and forecast

- Tropical Cyclone Collaborative Discussion (CoDi) Platform can provide instant and efficient online discussions for members' users. Users can share analysis and forecast products information that facilitate assessment of tropical cyclone situations.
- During this typhoon season, experts from CMA and VNMHA have already used CoDi to build up instant discussion for the typhoons MUN (1904) WIPHA(1907) PODUL(1912). The forecast track, possible time of landfalling in Vietnam, related rainfall and gale winds were fully discussed.
- Members' typhoon forecasters are encouraged to use this platform for instant or real time online discussions or information exchange such as tropical cyclone upgrade and landfall information.

2.3 POP3: Tropical Cyclone Research and Review

- Since its launch in February 2012, 31 issues of *Tropical Cyclone Research and Review* (TCRR) were published, covering the topics of tropical cyclone (TC) intensity and structure, TC climatology, review of TC in history, operational TC forecast verification, TC induced storm surge, flood or wave, and risk management etc. Authors come from 16 different countries and regions, two-thirds of them are international authors. We insist on strict peer-review process to ensure the quality of our journal, and two-thirds of the reviewers are also overseas experts. All of the published papers are available freely from the website. Readers spread over 126 Countries, the most are from the US, accounting for 51%. The full-text download capacity from January to

September 2019 exceeded 24763 times.

- Currently, TCRR has been included in two databases, one is the China National Knowledge Infrastructure (CNKI), and the other is the Emerging Sources Citation Index (ESCI), which is like SCI, owned by the Clarivate Analytics. ESCI includes high-quality, peer-reviewed publications representing both regional importance and emerging scientific fields not well-covered in more established journals.
- In order to have all the chairs from each Working Group to attend the meeting, the 3rd TCRR Editorial Board Meeting was held adjointly with AWG meeting on 8 November during the 14th IWS.

2.4 POP4: Transfer of the Technology of the Typhoon Operation System (TOS)

- Technology transfer has been conducted since 2014 upon Member's request.
- The main objectives are to train the typhoon forecasters on the use of the TOS and to provide follow-on technical assistance to Members on the implementation of TOS.
- Technology transfer has been conducted to Macao Meteorological and Geophysical Bureau in October 2019.

2.5 POP5: Verification of tropical cyclone operational forecast

- Forecasts of tropical cyclone tracks and intensity from deterministic guidance and ensemble systems in 2018 were evaluated and the results were reported to the 51st Session of Typhoon Committee (TC). Part of the work has been submitted to Tropical Cyclone Research and Review (TCRR).
- Established a new TC forecast and verification website with real-time forecast and verification, post-season verification and model products.

2.6 AOP1: Enhanced use of ensemble forecast

- Development with combination of EDA results and Global EPS of European Centre for Medium-Range Weather Forecasts (ECMWF), United Kingdom Met Office (UKMO), National Centers for Environmental Prediction (NCEP) and JMA has been in progress. JMA conducted a verification of tropical cyclone (TC) genesis against the ratio of ensemble members predicting sustained TC-like vortex with data from TS1701 to TY1918. JMA will continue working on tuning for higher hit rate.

- A probability-circle radii for operational TC track forecasts has been improved. The new radii are an average of approximately 20% smaller than before and express situation-dependent forecast uncertainty more appropriately. Statistical verification of the new radii has been done with data in 2019 until T1918 and will be done again with the entire TC events in the season by the end of this fiscal year.

2.7 AOP2: Improve the performances and impacts of South China Sea typhoon model

- TRAMS-V3.0 was developed in 2019 with a 9km resolution. Comparison between TRAMS-V3.0 and V2.0 was performed and V3.0 performed generally better than V2.0.
- Future plans in 2020 include improved model techniques, 4dvar data assimilation as well as typhoon ensemble forecasting.

2.8 AOP3: Development of regional radar network

- JICA training for VNMHA on radar QC and QPE was conducted in the JMA headquarters on 8-9 May, 2019.
- Field survey at a failed radar site in Lao PDR was conducted by WMO and JMA.
- The Guidelines for the Participation in Experimental Regional Radar Composite Data Exchanges in Southeast Asia was drafted among Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), JMA, MMD and TMD.
- Technical meeting on a weather radar network for Southeast Asia will be held in November to organize knowledge about previous activities mainly.

2.9 AOP4: Assessment report on the impact of climate change on tropical cyclone in TC region

- Draft of the report was finished in September 2019. It was already circulated to all TC Members for comments.
- The report is scheduled to be published during 52nd TC Session, and the major results have been submitted to Tropical Cyclone Research and Review (TCRR).
- This AOP will be closed after 52nd TC Session.

2.10 AOP5: Storm surge watch scheme

- Verification of storm surge prediction (multi-scenario prediction) in 2018 is being done for stations where sea level observations are available in University of Hawaii Sea Level Center (UHSLC) data base. The results will be published in the Annual Report of RSMC Tokyo 2018.
- In February 2019, JMA started providing astronomical tides and storm tides for stations where harmonic constants of astronomical tides are not available. FES2014 (Finite Element Solution) was adopted as global ocean tide solution to calculate astronomical tides and storm tides for such stations.

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

- More field campaigns were conducted by CMA and HKO in 2019, including for typhoons Wipha and Lekima. The demonstration research using the field campaign observation data continued and focused on the study of intensity and structure change in coastal area typhoons.
- New instrument such as LIDAR and drifting buoys were set up by CMA and HKO for future field experiments.
- The 2nd Joint Workshop with WWRP/WMO projects was held in Nanjing China in 2019. Technical presentations about the latest technologies and experiments have been delivered as well as the progress report of EXOTICCA presented by STI and HKO.

2.12 AOP7: Enhancing Utilization of Himawari 8/9 Products

- The project has been moved up from PP to AOP in 2019. JMA and MMD continue the joint development for the RDCA global coefficient.

2.13 AOP8: Parallel analysis of satellite data in operational tropical cyclone monitoring

- Parallel analysis of Himawari-8 and FY-4 show no significant difference in terms of FT and CI but discrepancy in TC intensity identification casually happens in the Northern West Pacific.
- Major disagreements between H-8 and FY-4 based analysis came from eye pattern.
- Anchored longitude of satellite might impact the effective capture of eye temperature.

2.14 PP1: Radar nowcasting based on RaINS/SWIRL

- The community version of the SWIRLS nowcasting system, a.k.a. “Com-SWIRLS”, has been completely revamped. The new version supports several operational radar data formats and enables users to configure forecast domain with arbitrary number of grid points, horizontal resolution and map projection.
- Collaboration of HKO and the MET Malaysia continued to develop the radar nowcasting techniques and blending system. The first training attachment was organized by the MET Malaysia on 17-27 September 2019.
- Forecasters from the Thailand Meteorological Department and the Guangxi Meteorological Observatory of the China Meteorological Administration joined the workshop to receive in-depth training of RaINS, as well as to apply their radar and NWP model data to conduct various forecast experiments on rainstorm cases.

2.15 PP2: Enhancement of disaster risk reduction against heavy rain in collaboration of AOP7 of WGH

- ICHARM and JMA had a meeting in JMA HQ building in April and discussed the necessary NWP model data for improvement in simulation results conducted in IFI platform. In addition, ICHARM shared a schedule of 2019 to seek for the best collaboration in awareness raising activities.
- ICHARM has been testing the effectiveness of JMA’s NWP model data to figure out which data to use for the project. JMA has been providing various test data to ICHARM according to its requests and preparing for data provision.

3. Conclusions and the proposed action plans for 2020

On the basis of the information provided by Members and the respective coordinators of the action plans and based on the discussions during the Parallel Meeting of 14th IWS, the following conclusions were reached:

- a. Members have made important progress in the implementation of the TC Strategic Plan during the year 2019.
- b. Members made significant progress during 2019 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 2019.
- d. The 2nd WGM Annual Meeting was held in Tokyo, Japan on 7-9 October 2019. The information and the major results were reported during the WGM parallel session of 14th IWS.
- e. Based on the discussion on the action plans for 2020 during the 14th IWS, it was concluded to adopt the action plans as follows:
 - i. The POP item 1-5 and AOP item 1-3, 5-8 will be continued in 2020.
 - ii. The AOP item 4 will be closed.
 - iii. The PP1 item will be continued and moved as the AOP4 in 2020.
 - iv. The PP2 item will be continued and moved as the AOP9 in 2020.
 - v. Establish one new PP item related to the workshop on typhoon forecasting techniques and WGM project progress review, as the cross-cutting project between WGM and TRCG, in 2020.
- f. The total budget proposed by WGM, which will be concurred at the AWG meeting during the 14th IWS, for undertaking the actions plans (AOPs, POPs and PPs) in 2020 is US\$44,000. In addition, the budget of US\$12,000 will be allocated for the cross-cutting project between WGM and TRCG.
- g. The complete WGM 2020 action plans (AOPs, POPs and PPs) including the actions, the success indicators, coordinators and budget is listed in [Annex II](#).

Annex I:

Status of the Perennial Operating Plans (POPs) of WGM in 2019

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
KRA1 KRA2 KRA6	1	Development of typhoon seasonal prediction system	(a) To provide the products of typhoon seasonal prediction for TC Members (b) To further develop the techniques of typhoon seasonal prediction	Submission of the progress report	/	KMA	/	Dr. Se Hwan Yang (KMA)	Continued (2015-)	Yes
KRA 6 SG 6b SG 6c	2	Collaborative Discussion (CoDi) Forum on TC Analysis and Forecast	(a) To encourage TC Members and TCS to nominate contact to get the account and password. (b) To encourage interested Members to join for trial during typhoon season. (c) 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 2019, includes the special issue. (b) Improvement of the editorial procedure and the journal's influence (includes inviting 2-3 visiting editors, and hold 3 rd editorial board meeting)	Submission of the progress report	US\$5,000	CMA	Members	Dr. Wang Dongliang, (CMA) Ms. Zhou Xiao (CMA)	Continued (2013 -)	Yes
KRA 1 KRA 2 KRA 6 SG 6b SG 6c	4	Transfer of the Technology of the Typhoon Operation System (TOS)	(a) To train the typhoon forecasters on the use of the TOS upon Member's request (b) To provide follow-on technical assistance to Members on the implementation of TOS	Submission of the progress report	US\$5,000	KMA	Members	Mr. Kim Dongjin (KMA)	Continued (2014 -)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
KRA1 KRA2 KRA6 SG 6b SG 6c	5	Verification of tropical cyclone operational forecast	(a) To carry out post-season verification and reliability analyses on the operational forecast of tropical cyclones and report to Committee Session (b) To provide the real time verification information on track and intensity forecast through WMO-TLFDP website (c) To further improve the evaluation system for tropical cyclone forecast, with special attention on genesis and ensemble forecast in conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme)	(a) Submission of the post-season verification report for TC Session (b) Progress report on the improvement of evaluation system for tropical cyclone forecast	US\$5,000	CMA, HKO	Members	Dr. Yu Hui (CMA), Mr. Wong Wai-Kin (HKO)	Continued (2015 -)	Yes

Status of the Annual Operating Plans (AOPs) of WGM in 2019

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
KRA 1 KRA 2 KRA 6 /SG 6b and 6c	1	Enhanced use of ensemble forecast	(a) To further develop tropical cyclone genesis guidance using early Dvorak Analysis (EDA) and global ensemble. (b) To improve probability-circle radii in TC track forecasts using	(a) Provide verification results. (b) Submit progress report	/	JMA	/	Dr. EITO Hisaki (JMA)	Continued (2011 -)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
			ensembles from multiple NWP centers and verify the new radii with tropical cyclone track data in 2019							
KRA1 KRA2 KRA6	2	Improve the performances and impacts of South China Sea typhoon model	(a) Increasing model products and enhancing the application of TRAMS (b) Further improving the forecasting ability of TRAMS, especially for the intensity and precipitation forecasting.	Submission of the assessment of performance report of model	/	CMA	Viet Nam, PAGASA, MMD	Dr. Chen Zitong (CMA)	Continued (2012 -)	Yes
KRA1 KRA2	3	Development of regional radar network	(a) To further refine quality control techniques applied to MMD and TMD radar networks, including dual pol. radars, to improve their quality of radar composites. (b) To implement and refine MMD and TMD's QPE calibration using rain-gauge with technical assistance of JMA. (c) To refine quality control techniques in VNMHA with technical assistance of JMA. (d) 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. (e) Submission of progress reports by TMD, MMD and VNMHA. Upon the receipt of the reports, holding	Submission of the progress report by involved Members	US\$8,000	TMD, MMD, JMA	Lao PDR, Viet Nam, Philippines	Ms. Lucia Euggong (MMD) Ms. Patchara Petvirojchai (TMD) Dr. EITO Hisaki (JMA)	Continued (2011 -)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
			<p>follow-up technical meeting(s) to identify a way forward.</p> <p>(f) To compose a user's guide among JMA, MMD and TMD.</p>							
KRA 1 KRA 2 KRA 4	4	Assessment report on the impact of climate change on tropical cyclone in TC region	<p>(a) To redistribute the survey form to acquire a more comprehensive survey result for evaluating the impacts of tropical cyclones in Typhoon Committee Region.</p> <p>(b) To publish the third assessment report by the end of 2019.</p>	Submission of the progress report	US\$5,000	Macao (China)	CMA, HKO, USA, JMA, KMA	Mr. Ho Kuok Hou (SMG)	Continued (2014-)	Yes
KRA 1 KRA 2 KRA 4 /SG4(a)	5	Storm surge watch scheme	<p>(a) To provide astronomical tide estimated by a global ocean tide solution to the stations where astronomical tide is not available, during the first quarter of 2019.</p> <p>(b) To add storm surge time series prediction points if requested by Members.</p> <p>(c) To publish verification results of storm surge predictions.</p> <p>(d) Request Members to provide complete hourly sea level data of at least one year to provide accurate astronomical tides at the stations.</p> <p>(e) Request Members to provide sea level observations during storm</p>	Submission of the progress report	/	JMA	/	Dr. EITO Hisaki (JMA)	Continued (2012-)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
			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, airship, rocket drop-sondes etc. (b) To collect and share the field observation and research data (c) Demonstration research on tropical cyclone intensity change conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme).	Submission of the progress report	US\$5,000 (special funding for 1-2 visiting research)	CMA, HKO	Participant Members (KMA, TMD)	Dr. LEI Xiaotu (CMA) Mr. WONG Wai-Kin (HKO)	Continued (2014-)	Yes
KRA 4 KRA 6 SG6(a)	7	Enhancing Utilization of Hiramari 8/9 Products	(a) A joint development commences in 2019, for the coefficient generation applicable to the global RDCA. JMA prepares a draft document necessary for the RDCA global coefficient's specifications, and MMD reviews it. (b) A meeting is held between JMA and MMD in the late 2019 to exchange views and opinions. (c) RDCA Global coefficient development is done until	Submission of the progress report.	US\$9,000	JMA	MMD, MSS, TMD, VNMHA	Mr. MATSUDA Kohei (JMA) Ms. Lucia Euggong (MMD) Mr. Wong Songhan (MSS) Ms. Patchara Petvirojchai (TMD) Mr. Vo Van Hoa (VNMHA)	Continued (2018-)	Yes

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks	Status of Completion
			<p>the end of 2019. JMA provides a coefficient set to MMD. MMD tests it and sends the results to JMA.</p> <p>(d) JMA provides initial support for development of RDCA by MSS and VNHMA.</p>							
	8	Parallel analysis of satellite data in operational tropical cyclone monitoring (Available data used in operational tropical cyclone analysis)	<p>(a) Use radar data to evaluate the quality of surface observations.</p> <p>(b) Develop wind structure estimation method based on available surface observations.</p>	Submission of the progress report	US\$4,500	CMA	Members interested in this project	Mr. Qian Chuanhai (CMA)	Continued	Yes

Status of the Preliminary Projects (PPs) of WGM in 2019

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organize r	Participan ts	Coordinator	Status of Completi on
KRA1 KRA2 KRA3	1	Radar nowcasting based on RaiNS/SWIRL	(a) Integrating radar data (b) Blending radar data with NWP data (c) Verification of RaiNS/SWIRL (d) Preparation of progress report	Submission of the progress report	US\$5,000	MMD HKO	TBC	Mr. Ambun Dindang (MMD), Mr. Yip Weng Sang (MMD) Mr. Wong Wai Kin (HKO)	Yes
Cross-c utting project	2	Enhancement of disaster risk reduction against heavy rain in collaboration of AOP7 of WGH	To support AOP7 of WGH through (a) Providing knowledge on JMA's NWP model as well as instruction for the use of NWP products that are available via DIAS (b) Sharing experiences on awareness raising to both local governments and public, including the appropriate use of products	Submission of the progress report	/	JMA	Philippines	Dr. EITO Hisaki (JMA)	Yes

Annex II:

Proposal for the Perennial Operating Plans (POPs) of WGM in 2020

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA1 KRA2 KRA6	1	Development of typhoon seasonal prediction system	(a) To provide the products of typhoon seasonal prediction for TC Members (b) To perform verification for Summer and Fall forecast (Total and impact number of Typhoon) (c) To perform verification for the four model algorithms	Submission of the progress report	/	KMA	/	Dr. Se Hwan Yang (KMA)	Continued (2015-)
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 2020. (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) Ms. Zhou Xiao (CMA)	Continued (2013 -)
KRA 1 KRA 2 KRA 6 SG 6b SG 6c	4	Transfer of the Technology of the Typhoon Operation System (TOS)	(a) Transfer of analysis and training module step by step (b) Packaging modules (forecast, analysis, training and statistics) (c) More technology transfer will be continued upon Member's requests.	Submission of the progress report	US\$6,000	KMA	Members	Mr. Kim Dongjin (KMA)	Continued (2014 -)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA1 KRA2 KRA6 SG 6b SG 6c	5	Verification of tropical cyclone operational forecast	(a) Continue to issue the summary report on verification of TC forecast products in 2019 typhoon season in western North Pacific. (b) Plan to issue the verification results (data and figures) for other basins. (c) Continue to strengthen international cooperation and promote the exchange of TC data and verification techniques through TLFDP.	(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 the Annual Operating Plans (AOPs) of WGM in 2020

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA 1 KRA 2 KRA 6 /SG 6b and 6c	1	Enhanced use of ensemble forecast	(a) To further develop tropical cyclone genesis guidance using early Dvorak Analysis (EDA) and global ensemble.	(a) Provide verification results. (b) Submit progress report	/	JMA	/	Dr. EITO Hisaki (JMA)	Continued (2011 -)
KRA1 KRA2 KRA6	2	Improve the performances and impacts of South China Sea typhoon model	(a) To improve model techniques and data assimilation. (b) To perform typhoon ensemble forecasting.	Submission of the assessment of performance report of model	/	CMA	Viet Nam, PAGASA, MMD	Dr. Chen Zitong (CMA)	Continued (2012 -)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA1 KRA2	3	Development of regional radar network	<p>(a) To further refine quality control techniques applied to the participants' radar networks, including dual pol. radars, to improve their quality of radar composites.</p> <p>(b) To implement and refine MMD and TMD's 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) To compose a user's guide among JMA, MMD and TMD.</p> <p>(e) Submission of progress reports by participants. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward.</p>	Submission of the progress report by involved Members	US\$8,000	TMD, MMD, JMA	Lao PDR, Viet Nam, Philippines	Mr. Asmadi Abdul Wahab (MMD) Ms. Patchara Petvirojchai (TMD) Dr. EITO Hisaki (JMA)	Continued (2011 -)
KRA1 KRA2 KRA3	4	Radar nowcasting based on RaiNS/SWIRL	<p>(a) Composite radar reflectively from multiple radars</p> <p>(b) Retrieve Radar Reflectively form 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	MMD HKO	TBC	Dr. Fariza Yunus (MMD) Mr. Nursalleh K Chang (MMD), Mr. Yip Weng Sang (MMD) Mr. Wong Wai Kin (HKO)	Moved from PP1 in 2019

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA 1 KRA 2 KRA 4 /SG4(a)	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. EITO Hisaki (JMA)	Continued (2012-)
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, airship drop-sondes etc. (b) To collect and share the field observation and research data (c) Demonstration research on tropical cyclone intensity change conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme).	Submission of the progress report	/	CMA, HKO	Participant Members (KMA, TMD)	Dr. LEI Xiaotu (CMA) Mr. WONG Wai-Kin (HKO)	Continued (2014-)

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organizer	Participants	Coordinator	Remarks
KRA 4 KRA 6 SG6(a)	7	Enhancing Utilization of Hiramari 8/9 Products	<p>(a) To improve RDCA algorithm through the joint development by JMA and MMD.</p> <p>(b) To provide supports for development of RDCA by MSS, TMD and VNMHA.</p> <p>(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.</p>	Submission of the progress report.	US\$9,000	JMA	MMD, MSS, TMD, VNMHA	Mr. MATSUDA Kohei (JMA) Mr. Asmadi Abdul Wahab (MMD) Mr. Wong Songhan (MSS) Ms. Patchara Petvirojchai (TMD) Mr. Vo Van Hoa (VNMHA)	Continued (2018-)
	8	Parallel analysis of satellite data in operational tropical cyclone monitoring (Available data used in operational tropical cyclone analysis)	<p>(a) To enlarge more SDT fixes back to 5yrs</p> <p>(b) To include other agencies (like JTWC, KMA, HKO) into parallel analysis,</p> <p>(c) To figure out the possible reliable coverage based on different bottom point from each satellite.</p>	Submission of the progress report	US\$7,000	CMA	Members interested in this project	Mr. Qian Chuanhai (CMA)	Continued
Cross-cutting project	9	Enhancement of disaster risk reduction against heavy rain in collaboration of AOP7 of WGH	<p>To support AOP7 of WGH through</p> <p>(a) To provide NWP model data, necessary for the project and available, to ICHARM.</p> <p>(b) To continue sharing knowledge and experience on awareness raising to governments including the appropriate use of products</p>	Submission of the progress report	/	JMA	Philippines	Dr. EITO Hisaki (JMA)	Moved from PP2 in 2019

Proposal for the Preliminary Projects (PPs) of WGM in 2020

SP's KRA & SG	No.	Objective	Action	Success Indicators	Funding (Req. & S.)	Organize r	Participan ts	Coordinator	Remarks
Cross-cutting project	1	Workshop on typhoon forecasting techniques and WGM project progress review	a) Training for the younger operational forecaster on the typhoon forecasting new techniques b) Review the progress of WGM projects	Submission of the progress report	US\$12,000	MMD (cooperation with WGM and TRCG)	WGM members and younger operational forecaster from host Member	Mr. Alui Bahari (MMD) T.C. Lee (HKO)	New project

Annex III Summary of the 2nd WGM Annual Meeting

ESCAP/WMO Typhoon Committee

Summary of the Second Annual Meeting of Working Group on Meteorology (WGM)

The second annual meeting of Working Group on Meteorology (WGM) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)/World Meteorological Organization (WMO) Typhoon Committee was successfully held in Tokyo, Japan between on 7-9 October, 2019. Here is the summary of the meeting:

1. Introduction

The Typhoon Committee consists of working groups on meteorology (WGM), hydrology (WGH), disaster risk and reduction (WGDRR), training and research coordination (TRCG) and advisory (AWG). In order to strengthen the communication among Members, prepare for collaboration in annual priority plans, the second annual WGM meeting was hosted by Japan Meteorological Agency (JMA), chaired by chairperson Dr. Lei Xiaotu from China and vice-chairpersons Dr. Landrico Dalida, Jr. from Philippines and Dr. Mohd Hisham bin Mohd Anip from Malaysia. Around 40 experts from 11 Members including China, Hong Kong China, Japan, Lao PDR, Macao China, Malaysia, Philippines, Republic of Korea, Thailand, USA and Viet Nam attended the meeting. The agenda and participant list can be found in Annex I and II, respectively.

2. Investigation of TC events

Although tropical cyclone (TC) forecasts continue to improve in recent years, events with large forecast errors (track and/or intensity) still happen every year. In addition, importance of social scientific perspectives is becoming more and more highlighted. Therefore, the meeting invited Members to discuss TC events of difficult or extreme cases, i.e., those with large forecast errors or caused significant damages to the Members, rare cases and TCs of Members' interest. 9 TCs were included in the discussion, namely JELAWAT (1803), LANE, SOULIK (1819), JEBI (1821), MANGKHUT (1822), YUTU (1826), PABUK (1901), WIPHA (1907) and LEKIMA (1909). The criteria for TD status for disturbances within monsoon depressions/gyres were also discussed.

The meeting encourages forecasters and scientists to pay more attention to TC events analysis and forecasting techniques developing with enhancing their cooperation, by activities such as uploading difficult or extreme cases discussed in the meeting to WMO website (<https://severeweather.wmo.int/TCFW/>), and to submit the article to TCRR journal.

3. Recent improvements in data & product sharing and analysis techniques

A total of 9 technical presentations were held in the meeting on recent progress in TC analysis methods, probability circles, best tracks, reconnaissance flights, use of dual polarization radar in TC analysis, use of artificial intelligence in intensity forecast, sea-surface AMV from Himawari-8/9, new satellite data or products from GEO-KOMPSAT-2A and for products of RSMC Tokyo for Nowcasting. Collaborations between Members on data sharing were also discussed and encouraged.

4. Enhanced cooperation between research and operational fields

In order to enhance the cooperation between research and operational fields, to push the research to operation (R2O) transfer, the second annual WGM meeting, discussion on the link between the scientist of WMO's expert team or its related projects and the operational forecaster of the Typhoon Committee. The meeting agreed that Meteorologist of the TCS will make an inquiry via email to the meeting participants and WGM focal points aiming at hearing:

- priorities among key research areas listed in the inquiry e-mail (to be distributed);
- other research priorities, if any;
- if the Members can nominate any scientists (forecasters/researchers/professors/decision-makers) who can lead and/or participate in the preparatory process of the project.

It was also agreed to include the discussion in the WGM meeting report to share with Members of other working groups, too, in the 14th IWS with appreciation for any inputs on research needs and priorities during 14th IWS.

5. Discussion and prioritization for future projects and meetings

This year, WGM set up 15 annual priority plans (including 5 permanent POPs, 8 AOPs and 2 preparatory PPs). Representatives from the 11 Members reviewed the progress of 8 AOPs and 2 PPs and discussed the plans for 2020. Based on the presentations of the Members in the meeting, the progress of WGM priority plans this year was smooth.

6. Date and venue for the third annual WGM meeting

The date and venue for the third annual WGM meeting was discussed. The preliminary result is that the possibility of Malaysia's hosting the next meeting will be pursued with the condition of financial support by Typhoon Committee, or to establish a new special PP conjunction with training course in cooperation with TRCG. The detail idea and discussion will be continued in the WGM parallel meeting at the 14th IWS to be held in Guam, USA between November 4-7, 2019.

Annex I Agenda of the Second Annual WGM Meeting

October 7 (Mon)		
09:00	<p>1. Opening Opening remarks by the Chair and Vice Chairs of WGM and the Head of RSMC Tokyo – Typhoon Center</p>	
	2. Adoption of the Agenda	
	Group Photo	
09:50	<p>3. Investigation of TC events Brief summary of TCs in 2018 and 2019, highlighting events selected for investigation</p>	10 min.
	<p>Investigation of selected TC events (20 minutes Coffee Break)</p> <ul style="list-style-type: none"> - TC events (Huge forecast error) in last year based on verification report (STI) - JELAWAT (T1803) - Hurricane LANE - SOULIK (T1819) - JEBI (T1821) - MANGKHUT (T1822) 	150 min. incl. break
12:30	Lunch	
14:00	<p>Investigation of TC events (Cont.) (20 minutes Coffee Break)</p> <ul style="list-style-type: none"> - YUTU (T1826) - PABUK (T1901) - WIPHA (T1907) - LEKIMA (T1909) - Discussion on criteria for TD status in operation for disturbances within monsoon depressions/gyres 	150 min. incl. break
	Wrap up of the discussion	15 min.
16:45	Tour of the forecast operation room	30 min.
17:15	End of the first day	
18:30	✿ Welcome Dinner ✿	
October 8 (Tue)		
09:00	<p>4. Recent improvements in data & product sharing and analysis techniques particularly for satellite, aircraft and other new observation data, models, and new analysis techniques including the use of big data or artificial intelligence (20 minutes Coffee Break)</p> <ul style="list-style-type: none"> - Revision of probability circle in TC track forecasts (RSMC Tokyo) - Recent Technique Developments of the CMA Best track (China) - Improvements of TC analysis method (RSMC Tokyo) - Discussion on the transmission of operational Dvorak fixes (United States) - Request for data sharing (Philippines) 	210 min. incl. break

	<ul style="list-style-type: none"> - Available data and AI in typhoon analysis (China) - ASWind (sea surface AMV) from Himawari-8/9 (RSMC Tokyo) 	
12:30	Lunch	
14:00	<p>Recent improvements in data & product sharing and analysis techniques (Cont.) (20 minutes Coffee Break)</p> <ul style="list-style-type: none"> - GEO-KOMPSAT-2A (Republic of Korea) - TC reconnaissance (Hong Kong) <ul style="list-style-type: none"> - TC analysis with dual polarization radar (RSMC Tokyo) - Products of RSMC Tokyo for Nowcasting (RSMC Tokyo) 	120 min. incl. break
	Wrap up of the discussion	15 min.
16:15	5. Enhanced cooperation between research and operational fields	
	<ul style="list-style-type: none"> - Introduction of the concept of seamless GDPFS pilot projects and related discussion in the Workshop of World Meteorological Centers in 2019 - Introduction of the 2nd Joint project meeting of WWRP projects (STI) 	30 min.
	<p>Discussion ~ Potential of the use of seamless GDPFS pilot projects for the needs ~ ~ Enhancing research activities, and linkage between research and operational fields ~</p>	30 min.
	Wrap up of the discussion	15 min.
17:30	End of the second day	

October 9 (Wed)		
09:00	6. Discussion and prioritization for future projects and meetings	
	<p>Quick review of AOPs and PPs for the progress and future plan, and discussion on new proposal in the next year (20 minutes Coffee Break)</p> <ul style="list-style-type: none"> - Review of AOP1~8 and PP1~2 for progress and future plan (10 min. each) - New proposal in 2020 	150 min. incl. break
	Plan for the 14th Integrated Workshop	20 min.
11:50	7. Date and place of the next WGM meeting	10 min.
12:00	8. Other business	10 min.
12:10	9. Summary of the meeting	10 min.
12:20	10. Closure Closing remarks by the Chair and Vice Chairs of WGM and the Head of RSMC Tokyo – Typhoon Center	
12:30	End of the 2nd WGM meeting	

Annex II Participants of the Second Annual WGM Meeting

ESCAP/WMO Typhoon Committee 2nd WGM (2019.10.7-9)

1	Typhoon Committee Secretariat		Mr. Clarence FONG
2	Chair (CMA/SMS)		Dr. LEI Xiaotu
3	China	CMA	Mr. QIAN Chuanhai
4		CMA/STI	Ms. XIANG Chunyi
5			Dr. YU Hui
6			Dr. TANG Jie
7	Hong Kong, China	HKO	Dr. Cho-Ming CHENG
8			Dr. Tsz-Cheung LEE
9	Lao PDR	DMH	Mr. Vanhdy DOUANGMALA
10	Macao, China	SMG	Mr. FOK Hou Fat
11	Malaysia	MMD	Dr. Mohd Hisham bin MOHD ANIP
12	Philippines	PAGASA	Dr Landrico DALIDA, Jr.
13			Mr. Renito B. PACIENTE
14	the Republic of Korea	KMA	Dr. CHA Eun Jeong
15			Ms. WON Seong Hee
16	Thailand	TMD	Mr. Surapong SARAPA
17	USA	RSMC Honolulu (NOAA/NWS)	Mr. Christopher BRENCHLEY
18	USA	NOAA/NWS	Mr. Raymond TANABE
19	Viet Nam	VNMHA	Dr. Hoang Phuc LAM
20	Japan	JMA	Mr. KAJIHARA Yasushi
21	Japan	RSMC Tokyo - Typhoon Center (JMA)	Dr. EITO Hisaki
22	Japan	RSMC Tokyo - Typhoon Center (JMA)	Ms. IGARASHI Yohko
23	Japan	RSMC Tokyo - Typhoon Center (JMA)	Mr. OIKAWA Yoshinori
24	Japan	RSMC Tokyo - Typhoon Center (JMA)	Dr. OYAMA Ryo
25	Japan	RSMC Tokyo - Typhoon Center (JMA)	Mr. FUKUDA Junya
26	Japan	JMA	Dr. KAZUMORI Masahiro
27	Japan	JMA	Mr. MATSUDA Kohei
28	Japan	JMA	Mr. HASEGAWA Hiroshi
29	Japan	JMA/MRI	Dr. SHIMADA Udai
30	Japan	JMA/MRI	Dr. YAMAGUCHI Munehiko
31	Japan	JMA/MRI	Mr. UMEHARA Akihito
32	Japan	RSMC Tokyo - Typhoon Center	Mr. KASAHARA Shingo

Observer

		(JMA)		
33	Japan	RSMC Tokyo - Typhoon Center (JMA)	Mr. KAWADA Hideyuki	Observer
34	Japan	JMA	Ms. ICHIKAWA Yuiko	Observer
35	Japan	JMA	Mr. HIGAKI Masakazu	Observer
36	Japan	JMA	Ms. HASEGAWA Jitsuko	Observer
37	Japan	Yokohama National University	Dr. FUDEYASU Hironori	Observer
38	Japan	Yokohama National University	Mr. Amit SINGH	Observer
39	Japan	ICHARM	Dr. IKEDA Tetsuya	Observer
40	Japan	ICHARM	Mr. TOMIZAWA Yosuke	Observer
41	Japan	RSMC Tokyo - Typhoon Center (JMA)	Mr. IZUMI Toshiharu	LOC
42	Japan	RSMC Tokyo - Typhoon Center (JMA)	Ms. ONO Marika	LOC
43	Japan	RSMC Tokyo - Typhoon Center (JMA)	Mr. NONAKA Nobuhide	LOC
44	Japan	JMA	Ms. IKEDA Michiko	LOC
45	Japan	JMA	Mr. YASUI Kazuki	LOC
46	Japan	JMA	Mr. KUSANO Naoto	LOC