

**ESCAP/WMO Typhoon Committee**

Fifty-fifth Session

07-09 March 2023

Macao, China

FOR PARTICIPANTS ONLY

WRD/TC.55/8.4

6 March 2023

ENGLISH ONLY

## **TRAINING & RESEARCH COORDINATION GROUP (TRCG)**

*(Submitted by TRCG Chair)*

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### Summary and Purpose of Document:

This document reviews past activities, progress and future plans of TRCG.

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### Action Proposed

The Committee is invited to:

- (a) note the training and research activities, and progress of development in TRCG as summarized in the APPENDIX B;
- (b) endorse the training and research priority areas as outlined in Section 5 of the APPENDIX B; and
- (c) endorse the work plan, Annual Operating Plan and budget of TRCG as outlined in Section 6 and Annexes VII and VIII of the APPENDIX B including the 4<sup>th</sup> TRCG Forum and TRCG Planning Meeting.

APPENDICES :

A : Draft text for inclusion at Session Report

B : TRCG Annual Report 2022

## APPENDIX A

### DRAFT TEXT FOR INCLUSION IN THE SESSION REPORT

#### 8.4 Report of the Training and Research Coordination Group

The Committee took note of the progress made in training and research activities as presented in the TRCG Report 2022 (Appendix ##)

The Committee appreciated China to organize successfully the Seventh International Distance Training Course on Tropical Cyclone Monitoring and Forecasting from 24 October to 4 November 2022. A total of 172 participants from 48 countries and regions joined the training workshop, including 21 trainees from TC Members.

The Committee recognized that the RSMC Tokyo Training Attachments were successively held in 11-13 January 2023 with a total of 51 participants participated in the Attachment. The Committee thanked Japan and WMO TCP for continuous support in this capacity-building initiative.

The Committee thanked Hong Kong, China for hosting research fellowship project in 2022/2023.

The Committee recognized efforts of TRCG to develop a training programme, identify and recommend experts for the Typhoon Forecasting Techniques Workshop hosted by Malaysia in October 2022 under a WGM PP.

The Committee was informed about the proposed plan of the 4<sup>th</sup> TRCG Forum and TRCG Planning Meeting to be further postponed to Q4 of 2023 in conjunction with the 18<sup>th</sup> IWS.

The Committee noted that the Roving Seminar would be conducted in Q2 of 2023 in Hanoi, Vietnam.

The Committee recognized TRCG's collaboration with the Asia-Pacific Typhoon Collaborative Research Center (AP-TCRC) to develop a draft attachment programme and research topic for the time-bound Pilot Project.

The Committee appreciated TRCG to organize a half-day Special Session at the 17<sup>th</sup> IWS on 30 November 2022 with presentations from invited experts from WGs on the latest development of TC analysis and forecasting techniques, applications of remote sensing data and AI/ML methods.

The Committee appreciated TRCG's inputs in support of training and research activities in connection with TC's cross-cutting projects.

The Committee noted that Mr WONG Wai-Kin of Hong Kong, China will step down from the Chairperson of TRCG, the nominations of Dr Anh Tien DO of Vietnam as the new Chairperson and Mr CHOY Chun-wing of Hong Kong, China as the new Vice Chairperson.

#### RECOMMENDATIONS of TRCG:

On the basis of the conclusions reached by the deliberation of Members, the TRCG made the following recommendations:

- a. To request Members to confirm their respective focal points as members of TRCG and update the list of resource persons as appropriate.
- b. To endorse the priority training and research areas as proposed in TRCG Annual Report 2022.

- c. To endorse the TRCG Work Plan for 2023-2024 and AOP 2023 (with Q1 of 2024) including the hosting of the Roving Seminar, the 4<sup>th</sup> TRCG Forum and TRCG Planning Meeting under the support of TCTF, and other budget requests which are incorporated into the budget proposal to be submitted by AWG.
- d. To appoint Dr Anh Tien DO (Vietnam) as the new Chairperson of TRCG, replacing Mr WONG Wai-kin.
- e. To appoint Mr CHOY Chun-wing (Hong Kong, China) as the new Vice Chairperson of TRCG.
- f. To re-appoint Dr CHA Eun Jeong (Republic of Korea) as the Vice Chairperson of TRCG.

## **APPENDIX B**

### **TRAINING & RESEARCH COORDINATION GROUP (TRCG)**

#### **Annual Report 2022**

Wai-Kin WONG (TRCG Chair)

Hong Kong, China

## **1. Introduction**

1.1 According to the Terms of Reference, TRCG is to promote research and training activities on various aspects of tropical cyclone analysis and forecasting, including assessment of tropical cyclones' impacts on Members' socio-economic development processes, and to encourage cooperation of efforts among Members. Towards this end, TRCG is expected to assist in:

- (a) identifying scientific and technical problems in the analysis and forecasting of tropical cyclones and their impacts on water resources and measures for disaster prevention and preparedness;
- (b) facilitating the exchange of experience and knowledge on the latest development and techniques related to the above problems;
- (c) coordinating training and research programmes, including activities in support of cross-cutting initiatives and other collaboration programmes among Members such as twinning and mentoring arrangement, aimed at improving the technical capacity and capability of Members to better serve the people in the region;
- (d) evaluating the effectiveness of training and research activities undertaken by TRCG, and providing support to other working groups in performing such evaluation; and
- (e) recommending to the Committee priority areas and long-term plans for cooperation in research and training in support of the targets and various KRAs of the Committee's Strategic Plan.

## **2. Membership**

2.1 The composition and members list of TRCG in 2022 are:

Chair: Mr WONG Wai-Kin (Hong Kong, China)  
Vice Chair: Dr CHA Eun Jeong (Republic of Korea)  
Members: Mr So Im Monichoth (Cambodia)  
Dr QIAN Qifeng\* (China)  
Mr SONG Yong Choi (DPR Korea)  
Mr HOSOMI Takuya (Japan)  
Dr SHIMADA Udai (Japan)

Dr Mayphou Mahachaleun (Lao PDR)  
 Mr HO Kuok Hou (Macao, China)  
 Mr Hamray bin Muhammad Yazit (Malaysia)  
 Ms Shirley David (Philippines)  
 Ms Joohyung Son / Ms Kyungho Lee<sup>#</sup> (Republic of Korea)  
 Mr Eugene Chong (Singapore)  
 Mr Tanya Thongnunui\* (Thailand)  
 Mr Eric Lau (USA)  
 Dr Do Tien Anh (Viet Nam)  
 (\* updated in November 2022; # effective from January 2023)

### 3. Major TRCG Activities in 2022

#### *COVID-19*

3.1 Effects of COVID-19 and its variants continued to affect the activities of ESCAP/WMO Typhoon Committee with suspension of in-person meetings and TRCG training activities. Travel restrictions, border closure, stringent quarantine and social distancing measures persisted in many countries/places though they have been gradually relaxed towards late 2022. The planned activities of TRCG for 2022/23 have been further postponed or cancelled. Information about the impact of COVID-19 on each TRCG related programme are described in the subsequent paragraphs where appropriate.

#### *TRCG Online Meeting*

3.2 An online meeting was convened on 18 August 2022 to review and update the planned activities (Figure 1). The Chair of WGM, Dr TANG Jie also joined the Meeting and discuss the progress of the development of the Asia-Pacific Typhoon Collaborative Research Centre (AP-TCRC) and collaborative activities under time-bound Pilot Project.

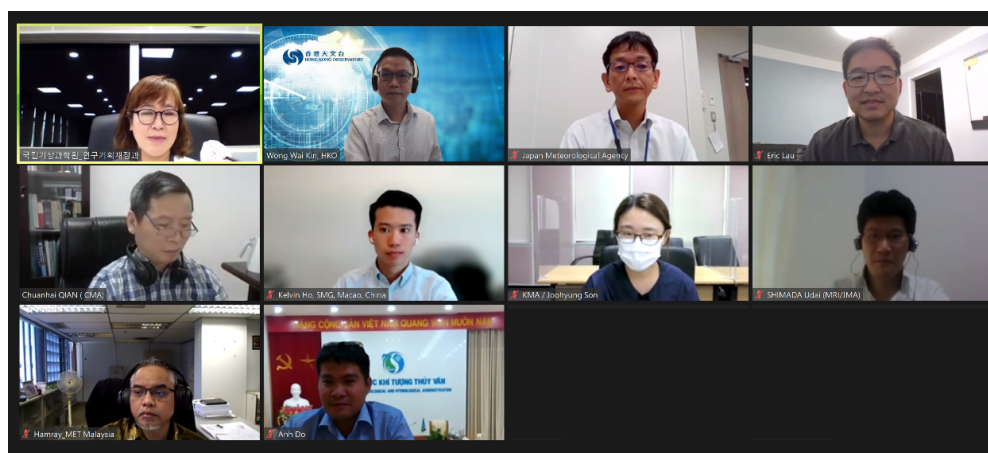


Figure 1: TRCG Online Meeting on 18 August 2022

### ***The Fourth TRCG Forum***

3.3 Due to COVID-19 situation, the 4th TRCG Forum (and in-person TRCG Planning Meeting) has been postponed to the Q4 of 2022, in conjunction with the 17th IWS in ESCAP Conference Center, Bangkok, Thailand. Unfortunately, in view of COVID-19 pandemic and unavailability of ESCAP Conference Center, the 17th IWS was changed to online. Considering that it would be: (a) more desirable to have a physical TRCG Forum to facilitate exchange / sharing of knowledge among the participants and the experts; and (b) an important opportunity for TRCG members to meet in-person for discussion and review of activities, the 4th TRCG Forum would be further postponed to the Q4 of 2023 to conduct back-to-back with the 18th IWS. Venue would remain in ESCAP Conference Center, Bangkok, Thailand with the same theme as before, namely, “Towards a typhoon resilient society”. A physical TRCG Planning Meeting would be convened during the TRCG Forum.

### ***TRCG Special Session in the 17th IWS***

3.4 To keep abreast of the latest development on TC research and forecast technique development, a half-day TRCG Special Session was organized on the 2nd day of 17th IWS (30 November 2022). A total of 7 speakers, including Chair and Vice Chair of TRCG, delivered presentations on a variety of topics including tropical cyclone intensification processes and estimate, wind scatterometry, flood resilience and urban flood warning, visualization of 3-dimensional structure of tropical cyclone and applications of AI/ML such as rainfall nowcast. The list of presentations and names of speakers can refer to the programme of the 17th Integrated Workshop.

### ***Roving Seminar / Visiting Lecturers Programme***

3.5 Roving seminars have been arranged for capacity building purposes on both research and operational aspects. Knowledgeable experts travel to Members’ countries and deliver lectures focused on subjects of current interest to operational centers. A record of all roving seminars previously organized can be found in Annex I.

3.6 Owing to COVID-19 pandemic and after consulting the hosting Member (Vietnam), the Typhoon Committee Roving Seminar, previously re-scheduled to Q4 of 2022 with the theme on “Impact based forecasting”, would be further postponed to Q2 of 2023. The Roving Seminar would be conducted in Hanoi, Vietnam. The dates and programme would be announced by Vietnam in due course.

### ***Typhoon Forecasting Techniques Workshop***

3.7 The Workshop on Typhoon Forecasting Techniques was conducted from 11 to 13 October 2022 in Petaling Jaya, Malaysia. The Workshop was hosted by the Malaysian

Meteorological Department (MET Malaysia) in collaboration with TRCG and the Working Group of Meteorology (WGM). The Workshop aimed to train younger operational forecasters of TC Members on tropical cyclone forecasting knowledge and techniques. Training was delivered in hybrid format that included various topics such as the Fundamental of Tropical Cyclone, interpretation of satellite data in operational tropical cyclone forecasting, analysis of satellite data in Tropical Cyclone, impact-based forecast and warning services approach, and tropical cyclone rainfall prediction and application of NWP products. The opening ceremony was inaugurated by the Director General of MET Malaysia, Mr Muhammad Helmi Abdullah (Figure 2). The lectures were delivered by 5 experts including two from the United States of America and the Vice-Chair of TRCG that they joined in person. There were 2 online speakers with one from the Korea Meteorological Administration and another from the Shanghai Typhoon Institute. The total number of participants were 24 that consisted of 19 physical attendees and 5 online. Both Chairmans of WGM and TRCG also delivered speeches during the opening ceremony.



Figure 2: Opening ceremony of the Typhoon Forecasting Techniques Workshop

### ***Forecasters' Training Attachment***

3.8 CMA's Typhoon Forecaster Training Programme, namely the Seventh International Distance Training Course on Tropical Cyclone Monitoring and Forecasting, has been successfully conducted online via its MOOC (Massive Open Online Courses) platform on 24 October – 4 November 2022. A total of 172 participants from 48 countries and regions joined the training workshop, including 21 trainees from TC. A variety of topics from tropical cyclone motion and structure, analysis and nowcast, use of satellite remote sensing techniques and experience sharing among participants and invited experts were delivered (Figure 3). The training workshop and programme design were well appreciated by the participants, more than 90% of them reflected that the training materials are highly useful and practical for operational applications. In addition to the above training programme, the WMO Training Centre (Nanjing)

hosted a training course titled “International Training Course on Tropical Cyclone Forecast” during 27 June to 8 July 2022.



Figure 3: CMA Typhoon Forecaster Training 2022

3.9 The RSMC Tokyo continued to organize the Attachment Training course remotely on 11 – 13 January 2023. A total of 51 forecasters participated in the Attachment. Invited lecture was delivered by Associate Prof. Ito of the University of the Ryukyus on recent progress in the understanding of tropical cyclone motion. Topics on new services and products of the RSMC Tokyo, Dvorak analysis, numerical weather forecasting of tropical cyclones and effective hazard information design and public awareness were presented.



Figure 4: RSMC Tokyo Attachment Training course



### ***Research Fellowship Scheme***

3.10 The Research Fellowships are awarded to Members to promote joint research through the exchange of visiting scientists on a short-term basis with voluntary funding and logistic support by host Members. One of the merits of the scheme is that the visiting fellow has a chance to work closely with forecasters, experienced scientists or forecast system developers at the host centre, providing an opportunity to transfer knowledge and latest research findings to operational applications. The scheme has worked well on the basis of bilateral cooperation mutually agreed between the host and the applicant.

3.11 Due to COVID-19, there was only one fellowship research project conducted in early 2022 hosted by Hong Kong, China on the topic entitled “Study on the characteristics and model forecast performance of rapid intensification (RI) of near-landfall tropical cyclones” via a remote approach. Fellowship from Hong Kong, China continued to demonstrate a feasible approach or as a new option for carrying out the project remotely at participant’s country/place, and to reduce substantial overheads in arranging administrative and logistical matters on physical travel, vaccination, and quarantine measures. The same research fellowship topic has also been offered by HKO and would conduct in Q1 2023. The awarded fellow, Ms Chunyi XIANG from China, would further review and consolidate initial findings, followed by evaluation of global NWP deterministic models and EPSs to capture RI of near-landfall tropical cyclones.

3.12 The fellowship offers by China and the Republic of Korea in 2022 were cancelled again due to difficulties arisen from physical attachments under COVID-19 pandemic. It is expected that the research fellowship and related in-person attachment visits would gradually resume with the relax of travel restriction and/or quarantine requirements. For future research fellowship arrangement, opportunities in coordination with AP-TCRC under time-bound pilot projects or related on-going research initiatives would also be explored. Information of the latest projects under the scheme, as well as a summary of previous fellowships awarded, can be found in Annex II. Publications and papers published in connection with the scheme are listed in Annex III.

### ***Asia-Pacific Typhoon Collaborative Research Centre (AP-TCRC)***

3.13 The 54th Session of TC (TC54) endorsed the theme of the time-bound pilot project, namely, “Advances in application of new observations and technologies for improving tropical cyclone prediction in various time scales and related disaster prevention activities”. Three research topics have been considered that AP-TCRC has planned to commence a first phase of attachment around / after mid-2023, preferably in-person visits, subject to COVID-19 situation by that time. A couple of online discussion meetings were conducted by the Chair and Vice Chair of TRCG with Dr TANG Jie and Dr FANG Zheqing of STI / AP-TCRC to formulate the attachment programme on the research topic “Understanding of rapid intensification

mechanism of tropical cyclone and influence of climate change”. Updates on the development of the attachment programme were presented at the 17th IWS and TC55. Draft document of the attachment visit including the application / nomination procedures and selection criteria, etc., was prepared that comments or suggestions from TRCG (and other WGs) would be collected. AP-TCRC has planned to host the first batch of attachment visit tentatively in mid- or latter part of 2023.

#### **4. Resource Support for Research and Training**

4.1 The available resource persons on specialized research subjects provided by Members are tabulated for reference in Annex IV.

4.2 The Pacific International Training Desk (PITD) (website: <http://pacificdesk.org>), funded by the USA's National Weather Service as part of the US contribution to the WMO Voluntary Cooperation Program (VCP) is currently managed by the Telecommunications and Social Informatics (TASI) Research Program at the University of Hawaii.

Up until 2016, all the PITD training were conducted at the RSMC Honolulu. In 2016, the PITD training reached out to include the Weather Service Offices in Micronesia. The training continued in a virtual capacity in 2022 due to the ongoing global pandemic. There are two levels of training offered: Basic (I) and Intermediate (II). The introductory training itself consists of four components: (a) basic forecaster training, to be implemented through use of e-learning modules that will be readily available to anyone; (b) a month long, instructor led onsite training program carried out at RSMC Honolulu and/or WFO Guam; (c) training on use of communications equipment, also to be funded by the VCP; and (d) in-Island workshops on severe weather event topics.

An intermediate course was started in 2018 and is offered as a supplemental, more in-depth course for returning students. The open webinars allow students from the Micronesia Weather Service Offices and from other Pacific Islands national meteorological services to continue their development in the field of Meteorology, Hydrology and Disaster Preparedness. It also offers an insight into other Pacific Islands national meteorological services and their operations. It has been planned to resume in-person PITD training in Guam and Honolulu beginning in January and Feb 2023.

#### **5. Prioritization of Training and Research Areas**

5.1 Based on the discussion during the 3<sup>rd</sup> TRCG Meeting held in conjunction with the 12th Integrated Workshop (IWS) in Jeju on 31 October – 1 November 2017, the priority and need for training and research activities are listed in the following as follows:

## ***(A) Meteorology***

### ***Monitoring***

- (i) application of Dvorak and microwave satellite image analysis techniques;
- (ii) application of radar-based analysis/products for landfalling tropical cyclones and monsoon depressions; and
- (iii) application of new observation technologies (such as aircraft reconnaissance, weather buoys, automatic weather network and mobile observations) in tropical cyclone monitoring and forecasting.

### ***Forecasting and warning***

- (i) development and enhancement of tropical cyclone analysis and forecast techniques from nowcast to medium range, and seasonal to long-range predictions.
- (ii) development of tropical cyclone structure and intensity forecasting techniques such as rapid intensification and wind structure;
- (iii) application of ensembles of guidance from global and regional dynamical models, ensemble prediction systems, conceptual models, statistical models and systematic knowledge-based approach;
- (iv) use of high-resolution numerical models with advanced data assimilation techniques;
- (v) rainfall forecasting: development of nowcasting and very short-range forecasting techniques, and understanding of interaction between tropical cyclones and monsoon;
- (vi) development of probability forecasting and extended outlook;
- (vii) development of impact-based forecast and risk-based warnings; and
- (viii) better understanding of wave, storm surge and marine forecasting.

## ***(B) Meteorology and Hydrology***

- (i) application of meteorological and hydrological information for forecasting of river flooding and urban flash flood; and
- (ii) geological hazards associated with heavy rain and tropical cyclones such as flash flood, mudslides and landslides.

## ***(C) Meteorology and DRR***

- (i) development of technical procedures to quantify forecast uncertainties and to convert probabilistic information into effective warnings;
- (ii) development of decision-making tools for DRR purpose, including the integration of forecast information with GIS and the use of automated information processing systems;
- (iii) making use of new communication technology; and
- (iv) community response and outreach effort for mitigation of the societal impact caused

by disasters.

**(D) Other Cross Cutting Topics**

- (i) better understanding of tropical cyclone related issues, such as rapid intensification, and impacts across different spatial and time scales, from mesoscale and synoptic analysis arising from El Nino / La Nina and global warming / climate change;
- (ii) forecasting and warning systems for better coastal protection from multi-hazards such as storm surge, high winds, heavy rain, river delta inundation and urban flooding;
- (iii) effective communication of warning messages to stakeholders, DRR users and communities at risk; and
- (iv) utilization of big data, social media, crowdsourcing and artificial intelligence in tropical cyclone and weather monitoring, impact assessment, DRR and public education.

**6. Future Directions and Strategies**

6.1 The 4-year cycle of TRCG work plan from 2018 to 2021 has reached its final stages, the research themes and training areas for the new cycle (2022-2025/2026) have been consolidated. Research projects and training opportunities arising from the time-bound Pilot Project under the collaboration of the Committee with the Asia-Pacific Typhoon Collaborative Research Centre (AP-TCRC) would be incorporated in the TRCG's work plan and Annual Operating Plan.

6.2 According to TRCG 4-year plan (2018-2021), the 4th TRCG Forum and TRCG Planning Meeting was originally planned to conduct in late 2021 with the 16th IWS. However, due to COVID-19, the 4th TRCG Forum has been postponed to late 2023 in conjunction with the 18th IWS (refer to para. 3.3 above). A proposed plan is described in Annex V. TRCG will follow up closely with AWG and TCS to work out the details of the programme and activities (e.g. invited lectures and break-out discussion sessions) for the proposed theme "Towards a typhoon resilient society".

6.3 The next Roving Seminar would be conducted during Q2 of 2023 in Hanoi, Vietnam with the theme on "Impact based forecasting".

6.4 TRCG will continue to support plans to have more cross-cutting training and research initiatives in consultation with the meteorology, hydrology and DRR components. Members are in turn encouraged to promote such initiatives through proactive involvement of the appropriate meteorological, hydrological and DRR personnel in their countries / places.

6.5 The current arrangements in RSMC Forecasters' Training Attachment operated smoothly in the past few years and will generally be maintained. Starting from 2019, the self-funded participation by Members will be considered. For better allocation of manpower, the

RSMC Attachment Training will continue to be conducted during the first quarter of the year. The possibility of involving hydrologists and DRR experts in RSMC Attachment Training, CMA Typhoon Forecaster Training, and TC Research Fellowship Schemes could be explored by corresponding Members. Moreover, training and research opportunities will be explored in collaboration with WGM, WGH, WGD RR, AP-TCRC and WMO Training Centre in Nanjing as well as various interested Members if the opportunity arises.

6.6 Review of the TRCG AOP 2022 (including the Q1 of 2023) can be found in Annex VI. A provisional work plan and the proposed AOP of 2023 (including Q1 of 2024) are described in Annex VII and Annex VIII respectively.

6.7 It is expected that the planned TRCG activities in 2023 would resume to in-person participation as uncertainties in travel, quarantine / isolation requirements due to coronavirus variants have been alleviated progressively. Moreover, TRCG will continue working closely with TCS and relevant Members to develop feasible options (for example hybrid mode of participation) or contingency plan as appropriate.

## Summary of Roving Seminars

| Year | Dates          | Venue            | Topic   | Lecturers  |
|------|----------------|------------------|---|--|
| 2003 | 20 – 21 Oct    | Seoul            | Interpretation of Typhoon Forecasts and Analyses  | Dr. H-J Kwon<br>Mr. MANNOJI Nobutaka                         |
|      | 22 – 24 Oct    | Hong Kong        | Interpretation of Satellite Data and Use of Radar Data in Operational Tropical Cyclone Forecasting                          | Dr. Mark Lander<br>Dr. P.W. Li<br>Dr. B.-J. Sohn             |
|      | 27 – 29 Oct    | Shanghai         | Interpretation of Satellite Data and Use of Radar Data in Operational Tropical Cyclone Forecasting                          | Dr. Mark Lander<br>Dr. P.W. Li                               |
| 2004 | 22 – 24 Nov    | Beijing          | Operational Application of Multi-model Ensemble Typhoon Forecasts   | Prof. Johnny C.L. Chan<br>Mr. MANNOJI Nobutaka               |
|      | 25 – 27 Nov    | Kuala Lumpur     | Operational Application of Multi-Model Ensemble Typhoon Forecasts   | Prof. Johnny C.L. Chan<br>Mr. MANNOJI Nobutaka               |
| 2006 | 4 – 7 Sep      | Ha Noi           | Tropical Cyclone Motion and Intensity, and Principles of Dvorak Method  | Prof. Johnny C.L. Chan<br>Mr. Joe Courtney<br>Dr. B.-J. Kim  |
| 2007 | 5 – 8 Sep      | Manila           | Satellite and Radar Analysis Techniques, and Tropical Cyclone Interaction with Monsoon Systems                              | Mr. Roger Edson<br>Mr. Bart Hagemeyer<br>Dr. NAKAZAWA Tetsuo |
| 2009 | 16 – 19 Nov    | Nanjing          | Forecasting of High-impact Weather associated with Tropical Cyclones, and Formulation and Communication of Warning Messages | Mr. S.T. Chan<br>Mr. Chip Guard<br>Mr. Sam Muchemi           |
| 2010 | 30 Nov – 3 Dec | Ubon Ratchathani | Tropical Cyclone Genesis and Large Scale Interaction  | Mr. S.M. Lee<br>Prof. Zhang Qinghong<br>Dr. Mark Lander      |

|      |                |               |  |  |
|------|----------------|---------------|--|--|
| 2011 | 20 – 23 Sep    | Petaling Jaya | Heavy Rain and Flood Hazards associated with Landfalling Tropical Cyclones | Dr. Siriluk Chumchean<br>Mr. H.Y. Yeung<br>Prof. Chen Charng-Ning          |
| 2012 | 30 Oct – 1 Nov | Seoul         | Tropical Cyclone Damage Assessment and Impact Forecast                     | DRR experts from NDMI<br>Ms. Xu Jing<br>Mr. W.K. Wong                      |
| 2014 | 3-5 Nov        | Hong Kong     | Warning communication  | Mr. Chip Guard<br>Mr. Ahmed Nadeem<br>Ms. Sandy, M.K. Song<br>Mr. K.L. Lee |
| 2015 | 4-6 Nov        | Lao PDR       | Flash flood and landslides   | Mr NAGAI Yoshiki<br>Prof. Xu-dong Fu<br>Dr. Dong-ryul Lee                  |
| 2016 | 15-17 Nov      | Viet Nam      | Storm Surge  | Mr. KOHNO Nadao<br>Mr. Author Taylor<br>Mr. Dickson Lau                    |
| 2018 | 20-22 Nov      | Singapore     | Application of Remote Sensing Technologies                                 | Mr. YAMASHITA Koji<br>Dr. Xiang Fang<br>Mr. Ray Kong                       |
| 2019 | 11-13 Nov      | China         | Quantitative precipitation estimation and forecasting (QPE/QPF)            | Mr. W C Woo<br>Mr. Erik Becker<br>Prof. NAKAKITA Eiichi                    |

## Summary of Awarded Research Fellowships

| Subject   | Fellow   | Host   | Period                           |
|---|--|--|----------------------------------|
| Analysis of evolution of landfalling tropical cyclones with a view to developing forecast guidance for wind and rain                            | Mr. XUE, Jianjun<br>(China)                          | Hong Kong Observatory  | 1 Feb – 31 Mar. 2001             |
| TC track forecasting with use of super-ensemble   | Dr. PENG, Taoyong<br>(China)                         | Korea Meteorological Administration                                | 15 Jun – 15 Nov 2001             |
| Near real-time analysis of the wind structure of tropical cyclones  | Dr. Nathaniel T. SERVANDO<br>(Philippines)           | Hong Kong Observatory  | 5 May – 4 Jul 2002               |
| Numerical modelling on typhoon intensity change   | Ms. YU, Hui<br>(China)                               | Kongju National University and Korea Meteorological Administration | 15 Jul – 15 Sep 2002             |
| Tropical cyclone track forecasting method   | Dr. KANG, Bom Jin<br>Dr. KIM, Tae Jin<br>(DPR Korea) | Shanghai Typhoon Institute   | Feb – Mar 2001<br>Oct – Nov 2002 |
| Analyses on the responses of extratropical transition of tropical cyclone to its environment  | Dr. Vicente B. MALANO<br>(Philippines)               | Korea Meteorological Administration                                | Jun – Aug 2004                   |
| Effect of tropical cyclone bogussing on model analysis and forecasts  | Ms. WANG, Dongliang<br>(China)                       | Hong Kong Observatory  | 11 Oct – 10 Dec 2004             |
| Evaluation of the model performance in typhoon prediction in the high-resolution global model (T426L40)   | Ms. Sugunyane YAVINCHAN<br>(Thailand)                | Kongju National University and Korea Meteorological Administration | 1 Aug – 30 Oct 2005              |
| Impact study of Moisture Data on TC forecasting in South China Sea and Western North Pacific  | Dr. Vicente B. MALANO<br>(Philippines)               | Hong Kong Observatory  | 20 Sep – 19 Nov 2005             |
| Using ensemble prediction system (EPS) information in tropical cyclone forecasting  | Ms. CHEN, Peiyan<br>(China)                          | Hong Kong Observatory  | 13 Oct – 12 Dec 2006             |
| Numerical simulation of Typhoon RUSA with a very high resolution mesoscale model, and calibration of intensity of typhoon with Kalman filtering | Mr. HOA, Vo Van<br>(Viet Nam)                        | Korea Meteorological Administration                                | Jun – Aug 2006                   |
| Use of EPS information in TC forecasting  | Mr. NGUYEN, Dang Quang<br>(Viet Nam)                 | Hong Kong Observatory  | 15 Sep – 14 Nov 2007             |
| Seasonality of Tropical Cyclone Activities over the Western North Pacific   | Ms. YING, Ming                                       | Korea Meteorological Administration                                | 22 Sep – 20 Dec 2008             |
| Study of high resolution non-hydrostatic model in prediction of landfalling tropical cyclones   | Mr. Santi SUMDIN<br>(Thailand)                       | Hong Kong Observatory  | 20 Oct – 19 Dec 2008             |
| Tropical cyclone bogus in NHM and its impact on forecast track and intensity  | Mr. QU, Anxiang<br>(China)                           | Hong Kong Observatory  | 29 Oct – 28 Dec 2009             |



|   |   |   |                                 |
|---|---|---|---------------------------------|
| Typhoon Vortex Initialization Scheme and typhoon Ensemble Forecast Techniques   | Ms. NGUYEN Thi Minh Phuong (Viet Nam) and Mr. Chatchai CHAIYASAEN (Thailand)  | National Meteorological Center, China Meteorological Administration | Early Dec 2009 – Early Feb 2010 |
| Improvement of typhoon analysis and forecast with KMA's TAPS  | Mr. TRAN Quang Nang (Viet Nam)  | Korea Meteorological Administration                                 | 1 Sep – 27 Nov 2010             |
| Study on the tropical cyclone genesis in the northwestern Pacific   | Mr. Kamol Promasakha Na SAKOLNAKHON (Thailand)  | Korea Meteorological Administration                                 | 1 Sep – 27 Nov 2010             |
| Typhoon Information Processing System   | Mr. NGUYEN Manh Linh (Viet Nam) and Ms. Kamolrat SARINGKARNPHASIT (Thailand)  | National Meteorological Center, China Meteorological Administration | 8 Oct – 8 Dec 2010              |
| Can the extreme rainfall associated with Typhoon Morakot (0908) happen in Hong Kong?  | Mr. HUANG, Yiwu (China)   | Hong Kong Observatory   | 29 Oct – 28 Dec 2010            |
| Improvement of typhoon analysis and forecast with KMA's TAPS  | Mr. Jori J. LOIZ (Philippines)  | Korea Meteorological Administration                                 | Sep – Nov 2011                  |
| Improvement of typhoon analysis and forecast with KMA's TAPS  | Mr. Chukiat THAIJARATSATIAN (Thailand)  | Korea Meteorological Administration                                 | Sep 2011                        |
| Implementation of Tropical Cyclone Intensity Forecast in the Tropical Cyclone Information Processing System (TIPS) of the Hong Kong Observatory   | Mr. Nursalleh K. CHANG (Malaysia)   | Hong Kong Observatory   | 24 Oct – 23 Dec 2011            |
| Improvement of Prediction Method for the Rapid Intensification of Tropical Cyclones in the South China Sea  | Dr. Sukrit KIRTSANG (Thailand)  | National Meteorological Center, China Meteorological Administration | 2 Nov – 29 Dec 2011             |
| Application of Numerical Ensemble Prediction in the Forecasting of Typhoon Sharp Turning Tracks   | Mr. Raymond C. ORDINARIO (Philippines)  | National Meteorological Center, China Meteorological Administration | 14 Nov 2011 – 13 Jan 2012       |
| Typhoon Analysis and Prediction System (TAPS), genesis and dissipation of tropical cyclones, and change of typhoon characteristics due to climate change  | Mr. Renito B. PACIENTE (Philippines), Ms. Plaidao KHUMCHAIYAPHUM (Thailand) and Mr. Bounteum SYSOUPHANTHAVONG (Lao PDR) | Korea Meteorological Administration                                 | May – June 2012                 |
| Enhancement of rainfall nowcast in tropical cyclone situation   | Mr. Maqrun Fadzli Mohd Fahmi (Malaysia) and Mr. Michael S. Bala (Philippines)   | Hong Kong Observatory   | 22 Oct – 21 Dec 2012            |
| Optimizing typhoon forecast using Typhoon Analysis and Prediction System (TAPS), and research on intensity and track forecasts using model ensemble, correction of track forecast bias according to synoptic patterns, and analysis of synoptic features and typhoon model forecast errors in anomalous typhoon tracks. | Dr. Bonifacio Galt Pajulelas (Philippine), Mr. Nguyen Huu Thanh (Vietnam), and Ms. Prapaporn Wongsaming (Thailand)      | Korea Meteorological Administration                                 | 1 May – 30 June 2013            |

|   |  |                                     |                                 |
|---|--|-------------------------------------|---------------------------------|
| Development of location-specific severe weather nowcasting techniques.  | Dr. Sukrit KIRTSANG (Thailand)   | Hong Kong Observatory               | 21 Oct – 20 Dec 2013            |
| Optimizing typhoon forecast using Typhoon Analysis and Prediction System (TAPS) and separate researches (typhoon-mid latitude pressure system interaction, study on the typhoon recurvature and moving speed, and study on the relationship between the central pressure and maximum sustained winds for typhoon) | Ms. Bai Lina (China)<br>Mr. Nguyen Tung Thanh (Vietnam)<br>Mr. Juanito S. Galang (The Philippines)   | Korea Meteorological Administration | 1 May – 30 June 2014            |
| Tropical Cyclone Genesis Forecast Technique   | Mr. Boonthum Tanglumlead (Thailand)  | Shanghai Typhoon Institute          | 1 Jul – 31 Aug 2014             |
| The utilization of ECMWF products in detecting storm tracks over the North Western Pacific  | Mr. Pak Sang Il and Mr Song Yong Chol (DPR Korea)  | Shanghai Typhoon Institute          | 1-30 Sept 2014                  |
| Nationwide Nowcast of Tropical Cyclone Rainfall   | Mr. Evan James K. Carlos (The Philippines)   | Hong Kong Observatory               | 6 Oct – 5 Dec 2014              |
| Optimizing typhoon forecast using Typhoon Analysis and Prediction System (TAPS), and research on typhoon monitoring, interpretation of satellite-based and radar images, typhoon track and intensity forecast and tropical depression or extra-tropical transition  | Ms. Akhom THAMALANGSY (Lao PDR)<br>Mr. Aldezar D. Aurelio (The Philippines),<br>Mr. Jose Frivaldo, JR. (The Philippines),<br>Mr. Somprat Srithagon (Thailand),<br>and Ms. DO Thi Thanh Thuy (Viet Nam) | Korea Meteorological Administration | 19 April - 2 May 2015           |
| Tropical cyclone genesis forecast technique   | Mr. Pak Sang Il (DPR Korea)<br>Mr. Ri Hak Il (DPR Korea)   | Shanghai Typhoon Institute          | 26 Oct - 25 Nov 2015            |
| Visiting editor for Tropical Cyclone Research and Review (TCRR)   | Dr. Jason Sippel (USA)<br>Dr. Nguyen Dang Quang (Viet Nam)   | Shanghai Typhoon Institute          | 6-13 Dec 2015<br>20-26 Dec 2015 |
| Development of objective guidance on tropical cyclone genesis forecast using global models  | Mr. Wen FENG (China)   | Hong Kong Observatory               | Mid Nov 2015 – mid Jan 2016     |
| Training for typhoon forecast<br>- Typhoon genesis and analysis<br>- Typhoon track and intensity forecast<br>- TAPS* operations and products  | Benison Jay N. Estareja(The Philippines)<br>Boonthum Tanglumlead(Thailand)<br>Narongpon Thongsang(Thailand)  | Korea Meteorological Administration | 1 May to 14 May 2016            |

|  |   |                                     |                                |
|--|---|-------------------------------------|--------------------------------|
| Tropical cyclone genesis forecast technique  | Mr. Pak Sang Il and Mr. Kim Kum Song (DPR Korea)  | Shanghai Typhoon Institute          | 24 October to 23 November 2016 |
| Visiting editor for Tropical Cyclone Research and Review (TCRR)  | Mr. Kamol Promasakha na Sakolnakhon (Thailand)<br>Dr. Chen Yi-Leng (USA)  | Shanghai Typhoon Institute          | 17-21 October 2016             |
| Tropical Cyclone Size Climatology  | Mr. Wei HONG (China)  | Hong Kong Observatory               | mid-Dec 2016 – 31 Jan 2017     |
| Training for typhoon forecast<br>- Typhoon genesis and analysis<br>- Typhoon track and intensity forecast<br>- TAPS* operations and products   | Ms. Pensiri Trisataya and Ms. Chuanpit Ngerchlad (Thailand)<br>Mr. Robert B. Badrina (The Philippines)<br>Ms. Hoang Thi Mai (Viet Nam)  | Korea Meteorological Administration | 16-29 April 2017               |
| Observational Study on Intensity and Structure of Offshore Typhoon for EXOTICCA  | Mr. Jaral Yiemwech (Thailand)<br>Ms. Khanh Hoa Bui Thi (Viet Nam)   | Shanghai Typhoon Institute          | September 2017                 |
| Benefit evaluation of Typhoon disaster prevention and preparedness   | Mr. Nursalleh Chang (Malaysia)  | Shanghai Typhoon Institute          | September 2017                 |
| Visiting Editor for Tropical Cyclone Research and Review   | Mr. Somkuan Tonjan (Thailand)<br>Dr. Doan Quang Tri from (Viet Nam)   | Shanghai Typhoon Institute          | February 2018                  |
| Tropical Cyclone Precipitation Verification  | No nomination was received  | Shanghai Typhoon Institute          | NA                             |
| Short-term Rainfall Forecast for Tropical Cyclone Using Himawari-8 Data and NWP Model Products   | Applicant who was accepted for the fellowship withdrew from the offer   | Hong Kong Observatory               | NA                             |
| Benefit evaluation of Typhoon disaster prevention and preparedness   | Mr. Nursalleh K Chang (Malaysia)  | Shanghai Typhoon Institute          | 2 May – 1 June 2018            |
| Training for forecasters:<br>- Tropical meteorology & climatology<br>- Processing observed meteorological variables<br>- Typhoon analysis and monitoring-<br>- Producing typhoon information using TAPS and TOS<br>- Seasonal typhoon prediction | Mr. Nuthakit Singhaphet, (Thailand)<br>Mr. Tran Quang Nang, Typhoon (Viet Nam)<br>Dr. Guanbo Zhou (China)<br>Mr. Robb Prieto Gile (the Philippines)<br>Mr. Wan Muhammad Hafiz Bin Husin, (Malaysia) | Korea Meteorological Administration | 23 April to 4 May 2018         |

|  |  |                                     |  |
|--|--|-------------------------------------|--|
| Short-term Rainfall Forecast for Tropical Cyclone Using Himawari-8 Data and NWP Model Products   | Ms. Nguyen Thu Hang (Viet Nam)   | Hong Kong Observatory               | January – March 2019                   |
| Training for forecasters:<br>- Tropical meteorology & climatology<br>- Processing observed meteorological variables<br>- Typhoon analysis and monitoring-<br>- Producing typhoon information using TAPS and TOS<br>- Seasonal typhoon prediction | Ms. Reyes Sheilla Mae R. (the Philippines)<br>Mr. Tran Van Vu (Viet Nam) | Korea Meteorological Administration | 20 May to 14 June 2019                 |
| Visiting Editor for Tropical Cyclone Research and Review   | Prof. Kimberly Wood (USA)<br>Prof. Shishir Dube (India)                  | Shanghai Typhoon Institute          | 24-29 March 2019<br>13-19 October 2019 |
| Integrated Precipitation Estimator using Radar and Satellite (IPERS) for Tropical Cyclone Rainfall (TC) Analysis and Nowcasting  | Mr. Benison Jay N Estareja (the Philippines)                             | Hong Kong Observatory               | January – February 2020                |
| Verification of tropical cyclone wind structure forecasts from global NWP models and ensemble prediction system  | Ms LU Xiaoqin (China)  | Hong Kong Observatory               | Q1 2021                                |
| Study on the characteristics and model forecast performance of rapid intensification (RI) of near-landfall tropical cyclones (TCs)   | Mr Nawin Sermsook (Thailand)   | Hong Kong Observatory               | Q1 2022                                |
| Study on the characteristics and model forecast performance of rapid intensification (RI) of near-landfall tropical cyclones (TCs)   | Ms XIANG Chunyi (China)  | Hong Kong Observatory               | Q1 2023                                |

**TRCG Publications / Papers**

Xue, J.J., 2002: Structural and Diagnostic Analyses of Landfalling Tropical Cyclones near Hong Kong in 1999 and 2000. Typhoon Committee Annual Review 2001, pp. 153-161

Servando, N.T., P.W. Li and E.S.T. Lai, 2003: Near Real-time Analysis of the Wind Structure of Tropical Cyclones. Typhoon Committee Annual Review 2002 (in CD form)

Peng, T.-Y., H.-J. Kwon, W.-J. Lee, and J.-H. Lim, 2005: A systematic approach to tropical cyclone track. *The International Journal of Systems & Cybernetics*. **34**, 681-693.

Wang, D.L., W.K. Wong and E.S.T. Lai, 2005: A Study on Tropical Cyclone Bogussing Strategies in NWP Model Analysis and Forecast. Typhoon Committee Annual Review 2004.

Yu, Hui and H. Joe Kwon, 2005: Effect of TC–Trough Interaction on the Intensity Change of Two Typhoons. *Weather and Forecasting*. **20**, 199–211.

Malano, V.B., W.K. Wong and E.S.T. Lai 2006: Effect of Moisture Data to the Numerical Simulation of Tropical Cyclone in the Western North Pacific. Typhoon Committee Annual Review 2005, pp. 242 – 251.

Chen, P.Y. and S.T. Chan, 2009: Use of the JMA Ensemble Prediction System for Tropical Cyclone Intensity Forecasting. Typhoon Committee Annual Review 2008, pp. 276-285.

Nguyen, D.Q. and S.T. Chan, 2009: Study on Application of Ensemble Prediction System Information in Tropical Cyclone Track Forecasting. Typhoon Committee Annual Review 2008, pp. 286-291.

Wong W.K., S. Sumdin, and E.S.T. Lai 2010: Development of Air-Sea Bulk Transfer Coefficients and Roughness Lengths in JMA Non-hydrostatic Model and Application in Prediction of an Intense Tropical Cyclone. *Scientific Online Letters on the Atmosphere (SOLA)*, **6**, 65-68.

Chan, S.T. and Y. Huang, 2012: Can the Extreme Rainfall Associated with Typhoon Morakot (2009) Happen in Hong Kong? *Tropical Cyclone Research and Review*, **1**, 1-15.

Chang, N.K., L.S. Lee and Y.S. Li, 2012: Comparison of Performance of Various Multiple-Model Ensemble Techniques in Forecasting Intensity of Tropical Cyclone. *Tropical Cyclone Research and Review*, **1**, 353-360.

Woo, W.C., K.K. Li and Michael Bala 2014: An Algorithm to Enhance Nowcast of Rainfall Brought by Tropical Cyclones Through Separation of Motions[J]. Tropical Cyclone Research and Review, 2014, 3(2): 111-121. doi:10.6057/2014TCRR02.04

Choi, K-S, Prapaporn Wongsaming, S. Park, Y. Cha, W. Lee, I. Oh, J-S Lee, S-B Jeong, D-J Kim, K-H Chang, J. Kim, W-S Yoon, and J-H Lee, 2013: An Analysis of Model Bias Tendency in Forecast for the Interaction between Mid-latitude Trough and Movement Speed of Typhoon Sanba. Jour. Korean Earth Science Society, 34, 303-312.

Feng, W, W K Wong, Y T Tam and CW Choy, 2016 : Tropical Cyclone Genesis Forecasting based on Thresholds of Multiple Physical Parameters and Verification of Performance using ECMWF Model, Journal of Tropical Meteorology, 32(6), 908-917.

Lee, T C and Edwin S T Lai, 2018: Training and Research under the Typhoon Committee. Tropical Cyclone Research and Review, 7(1), 23-30. DOI: 10.6057/2018TCRR01.03

Lu X., W.K. Wong, K.C. Au-Yeung, C.W. Choy, H. Yu, 2022: Verification of tropical cyclones (TC) wind structure forecasts from global NWP models and ensemble prediction systems (EPSs), Tropical Cyclone Research and Review, 11 (2), <https://doi.org/10.1016/j.tcr.2022.07.002>.

## List of Resource Persons

| Member                       | Specialties  | Name                        | E-mail                                 | Affiliation                         |
|------------------------------|--|-----------------------------|--|-------------------------------------|
| <i>(A) Data Assimilation</i> |  |                             |  |                                     |
| China                        | TC vortex initialization                                       | LIANG, Xudong               | Liangxd@mail.typhoon.gov.cn            | Shanghai Typhoon Institute          |
|                              | TC intensity estimation by radar, satellite, SSMI and QuikScat | GAO, Shuanzhu<br>ZHOU, Bing | gaosz1129@sina.com<br>bingz@cma.gov.cn | National Meteorological Center      |
|                              | Radar data quality control and assimilation scheme             | GONG, Jiandong              | gongjd@cma.gov.cn                      | National Meteorological Center      |
| Hong Kong, China             | TC data assimilation, ensemble radar assimilation              | K. K. Hon                   | kkhon@hko.gov.hk                       | Hong Kong Observatory               |
| Japan                        | Satellite data assimilation                                    | OKAMOTO Kozo                | kokamoto@mri-jma.go.jp                 | Meteorological Research Institute   |
|                              | Data assimilation  | ISHIBASHI Toshiyuki         | ishibasi@mri-jma.go.jp                 | Meteorological Research Institute   |
| Republic of Korea            | Typhoon bogussing  | HA, Ji-Hyun                 | jhha80@korea.kr                        | Korea Meteorological Administration |
|                              | Satellite data analysis  | CHUN, Hyoung-Wook           | chunhw@korea.kr                        | Korea Meteorological Administration |
|                              | Radar data analysis  | HA, Jong-Chul               | bellfe@korea.kr                        | Korea Meteorological Administration |

| <b>Member</b>               | <b>Specialties</b>   | <b>Name</b>                          | <b>E-mail</b>   | <b>Affiliation</b>  |
|-----------------------------|--|--------------------------------------|---|---|
| USA (western North Pacific) | TC analysis, satellite interpretation, use of microwave imagery and scatterometer data | Tom LEE<br>Peter BLACK<br>Paul CHANG | Lee@nrlmry.navy.mil<br>Peter.Black.ctr@nrlmry.navy.mil<br>Paul.S.Chang@noaa.gov | NRL, Monterey, CA<br>NRL, Monterey CA<br>NOAA/NESDIS, Suitland MD |
| <b>(B) Modelling</b>        |  |                                      |   |   |
| China                       | Numerical schemes of TC model  | DUAN, Yihong                         | duanyh@mail.typhoon.gov.cn  | Shanghai Typhoon Institute  |
|                             | TC model physics and bogussing schemes   | MA, Suhong                           | mash@cma.gov.cn   | National Meteorological Center                                    |
|                             | Ensemble track forecasting   | ZHOU, Xiaqiong                       | zhouxq@mail.typhoon.gov.cn  | Shanghai Typhoon Institute  |
|                             | Typhoon modelling  | LIANG, Xudong                        | Liangxd@mail.typhoon.gov.cn   | Shanghai Typhoon Institute  |
| Hong Kong, China            | Mesoscale and ensemble TC modelling  | K.K. HON                             | kkhon@hko.gov.hk  | Hong Kong Observatory   |
| Japan                       | Ensemble track forecasting   | KAWABATA Yasuhiro                    | kawabata@mri-jma.go.jp  | Meteorological Research Institute                                 |
|                             | TC-ocean interaction (incl. mixed-layer ocean and ocean surface wave modelling)        | WADA Akiyoshi                        | awada@mri-jma.go.jp   | Meteorological Research Institute                                 |
|                             | TC modelling   | TSUJINO Satoki                       | satoki@mri-jma.go.jp  | Meteorological Research Institute                                 |
|                             | Storm surge / wave modelling   | KOHNO Nadao                          | nkohno@mri-jma.go.jp  | Meteorological Research Institute                                 |



| <b>Member</b>                 | <b>Specialties</b>   | <b>Name</b>           | <b>E-mail</b>                                 | <b>Affiliation</b>   |
|-------------------------------|--|-----------------------|---|--|
| Republic of Korea             | Global NWP model   | CHOI, Hyun-Joo        | hjchoi81@korea.kr                             | Korea Meteorological Administration                        |
|                               | Ensemble track forecasting   | SHIN, Hyun Cheol      | sinhyo@korea.kr                               | Korea Meteorological Administration                        |
|                               | Storm surge / wave modelling   | CHANG, Pil-Hun        | phchang@korea.kr                              | Korea Meteorological Administration                        |
| USA (western North Pacific)   | TC Modeling<br>Extratropical Transition<br>TC Genesis<br>Sub-Tropical Systems<br>Structure | Jim DOYLE<br>Pat HARR | James.Doyle@nrlmry.navy.mil<br>paharr@nps.edu | NRL, Monterey CA<br>Naval Postgraduate School, Monterey CA |
|                               |  | Jenni EVANS           | evans@meteo.psu.edu                           | Pennsylvania State Univ                                    |
| Viet Nam                      | Computational fluid dynamics and modelling   | LE, Duc               | leducvn@yahoo.com                             | National Hydro-Meteorological Service of Viet Nam          |
| <b><i>(C) Forecasting</i></b> |  |                       |   |  |
| China                         | Track and intensity forecasting  | LEI, Xiaotu           | Leixt@mail.typhoon.gov.cn                     | Shanghai Typhoon Institute                                 |
|                               | Long-range prediction of typhoon   | XU, Ming              | Xum@mail.typhoon.gov.cn                       | Shanghai Typhoon Institute                                 |
| Hong Kong, China              | TC climatology and best track analysis   | Y.S. LUI              | yslui@hko.gov.hk                              | Hong Kong Observatory                                      |
|                               | Radar and satellite nowcasting in TC   | W.K. WONG             | wkwong@hko.gov.hk                             | Hong Kong Observatory                                      |
|                               | TC intensity, structure and landfall impact  | W.K. WONG             | wkwong@hko.gov.hk                             | Hong Kong Observatory                                      |

| <b>Member</b>  | <b>Specialties</b>  | <b>Name</b>                | <b>E-mail</b>                                 | <b>Affiliation</b>   |
|--|---|----------------------------|---|--|
|  | Long-range forecasting of TCs   | S.M. LEE                   | smlee@hko.gov.hk                              | Hong Kong Observatory  |
|  | TC motion, intensity, size, modelling and seasonal prediction   | Johnny C.L. CHAN           | Johnny.Chan@cityu.edu.hk                      | City University of Hong Kong.  |
| Japan  | Satellite data analysis, use of microwave imagery, AMSU   | OYAMA Ryo                  | oyama@met.kishou.go.jp                        | Japan Meteorological Agency  |
|  | Doppler radar data analysis   | SHIMADA Udai               | ushimada@mri-jma.go.jp                        | Meteorological Research Institute  |
| Republic of Korea  | Track and intensity forecasting   | LEE, Kyung-Ho              | khlove1119@korea.kr                           | Korea Meteorological Administration  |
|  | Long-range prediction of typhoon  |                            |   |  |
| Singapore  | Seasonal prediction of typhoon  | CHOW Kwok Wah              | CHOW_Kwok_Wah@nea.gov.sg                      | Meteorological Service Singapore<br>National Environment Agency                |
| USA (western North Pacific)<br>USA (western North Pacific) | TC analysis and forecasting, seasonal prediction, use of microwave imagery and scatterometer data, Dvorak technique | Mark LANDER<br>Roger EDSON | mlander@uguam.uog.edu<br>Roger.Edson@noaa.gov | University of Guam (WERI)<br>National Weather Service, Forecast Office<br>Guam |

| <b>Member</b>                  | <b>Specialties</b>  | <b>Name</b>                         | <b>E-mail</b>   | <b>Affiliation</b>                                |
|--------------------------------|---|-------------------------------------|---|---|
|                                | Satellite data analysis,<br>use of microwave<br>imagery   | Jorel TORRES<br>Dan LINDSEY         | Jorel.Torres@colostate.edu<br>Dan.Lindsey@colostate.edu | NOAA/NESDIS at CIRA,<br>Colorado State University |
|                                | Satellite data analysis,<br>use of microwave<br>imagery, automated<br>Dvorak Technique,<br>AMSU | Chris VELDEN<br>Derrick HERNDON     | chris.velden@ssec.wisc.edu<br>dherndon@ssec.wisc.edu    | CIMSS,<br>University of Wisconsin-Madison         |
|                                | Satellite data analysis,<br>use of microwave<br>imagery, AMSU                                   | John KNAFF                          | john.knaff@noaa.gov                                     | NOAA/NESDIS at CIRA,<br>Colorado State University |
|                                | Satellite-based rainfall<br>estimates in TCs (eTRaP)  | Bob KULIGOWSKI<br>Shelden KUSSELSON | bob.kuligowski@noaa.gov<br>sheldon.kusselson@noaa.gov   | NOAA/NESDIS<br>Suitland, Maryland                 |
| <b><i>(D) Application</i></b>  |   |                                     |   |   |
| Hong Kong,<br>China            | TC warning systems<br>and operations  | H.Y. YEUNG                          | hyyeung@hko.gov.hk                                      | Hong Kong Observatory                             |
|                                | TC information<br>visualization and display<br>systems  | C.K. PAN                            | ckpan@hko.gov.hk  | Hong Kong Observatory                             |
| USA (western<br>North Pacific) | TC warning and disaster<br>preparedness, seasonal<br>prediction, Dvorak<br>technique            | Chip GUARD                          | chip.guard@noaa.gov                                     | NOAA National Weather Service<br>Guam             |

## Proposed plan for the 4<sup>th</sup> TRCG Forum/Planning Meeting in 2023 in conjunction with the 18<sup>th</sup> IWS of the Typhoon Committee

### 1. Date/location

Q4 of 2023 (late November), in conjunction with the 18<sup>th</sup> IWS to be held in ESCAP Conference Center, Bangkok, Thailand.

### 2. Proposed theme

The proposed theme for the 4<sup>th</sup> TRCG Forum will be “*Towards a typhoon resilient society*” which echoes the vision of the Tokyo Statement announced in 2019.

### 3. Draft programme

It is proposed that the 4<sup>th</sup> TRCG Forum and 18<sup>th</sup> IWS will be a 4 to 5-day event (2 days Forum + 2 to 2.5 days IWS (including the post-IWS AWG Meeting)).

| Time | Day 1  | Day 2   | Day 3  | Day 4   | Day 5  |
|------|--|---|--|---|--|
| AM   | Opening Ceremony   | Technical presentations<br>(7-8 presentations, 20-min each) | WGM, WGH, WGDRR and TRCG Meetings (parallel sessions)          | WGM, WGH, WGDRR and TRCG Meetings - Cont'd (parallel sessions, if required)   | Reserved half day for Plenary Session (if required)<br><br>Post-IWS AWG Meeting (AWG Members only) |
|      | Keynote presentations (3-4 presentations, 30-min each)   |   |  | <b>Plenary Session</b><br>(1) Reports of WGM and WGH  |  |
| PM   | Keynote presentations (3-4 presentations, 30-min each)   | Topical discussions (3-4 Breakout groups)                   | WGM, WGH, WGDRR and TRCG Meetings - Cont'd (parallel sessions) | <b>Plenary Session</b><br>(2) Reports of WGDRR and TRCG<br>(3) Discussion of AOPs and Strategic Plan<br>(4) Other business<br>(5) Closing |  |
|      | Technical presentations (3-4 presentations, 20-min each) | Wrap up discussions (Plenary)                               |  |   |  |

### 4. Presentation/discussion arrangements:

The Forum is expected to include Keynote/Technical Presentations. About 6-8 Keynote Presentations will be delivered by invited speakers (nominated by WG Chairs). Other Technical Presentations (around 10-12) will be contributed by IWS participants / WG representatives (nominated by TC Members, similar to the technical presentations of IWS). Similar to previous Forums, “topical discussions” in breakout group approach will also be arranged for participants to discuss concerned topics with the invited speakers.

### **5. TRCG Planning Meeting (Day 3)**

The TRCG Planning Meeting is a quadrennial gathering of the TRCG Members to review the activities, and to discuss the new plan and priority areas of TRCG.

### **6. Budget:**

Additional funding to support the participation of up to 8 invited speakers and about 9 TRCG Members (others will be supported by IWS budget) is estimated to be about USD 26,000.

### **7. Contingency arrangements**

Facilities would be arranged for virtual attendance. Subject to travelling difficulties / restrictions arising from the development of coronavirus variants, the details of contingency arrangements would be confirmed with AWG and TCS.

| Review of Training and Research Coordination Group (TRCG) Annual Operating Plan 2022 (including Q1 of 2023) |         |  |   |                    |   |  |                              |   |  |                             |  |
|---|---------|--|---|--------------------|---|--|------------------------------|---|--|-----------------------------|--|
| Objective Number  | KRA     | Objective  | Action  | Other WGs Involved | TCS Responsibility                                | Expected Quarter Completed   | Other Organizations Involved | Success Indicators  | Funding Required                       | Funding Sources             | Review and Target Met (Yes/No)                     |
| 1   | KRA 1-3 | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Attachment of forecasters from TC Members to RSMC Tokyo | nil                | Provision of administrative and logistic support. | Q1 (11-13 Jan 2022)  | RSMC Tokyo, WMO              | Assessment as given in RSMC Tokyo report.   | USD 11,000*                            | TCTF and Member self-funded | Yes (conducted online)                             |
| 2   | KRA 1-3 | To facilitate technology transfer among TC Members through research and development initiatives.   | Research Fellowship                                     | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q1 of 2022   | TC Members                   | Publication of research findings and development output in TCRR or other journals.      | Fellowship offered by voluntary hosts. | TC Members                  | Yes (conducted online)                             |
| 3   | KRA1-3  | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Up to 4 forecasters from TC to CMA Forecaster Training  | nil                | Provision of administrative and logistic support. | Q3-Q4 (24 Oct – 4 Nov 2022)  | CMA                          | Assessment as given in CMA report.  | Participation supported by CMA         | CMA                         | Yes (conducted online)                             |
| 4   | KRA 1-3 | To: (a) implement training initiatives in the priority operational and research areas as identified in the TRCG annual report; and (b) enhance Members' capability and capacity in the assessment of damage and pre-assessment of potential impact caused by landfalling TCs | 4 <sup>th</sup> TRCG Forum and Planning Meeting         | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Postponed to Q4 of 2023 (in conjunction with the 18 <sup>th</sup> IWS) | -                            | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 26,000                             | TCTF                        | Postponed to Q4/2023 with the 18 <sup>th</sup> IWS |
| 5   | KRA 1-3 | To: (a) implement training initiatives in the priority operational and research areas as identified in the TRCG annual report; and (b) enhance Members' capability and capacity in the assessment of damage and pre-assessment of potential impact caused by landfalling TCs | Roving Seminar [Impact based forecasting]               | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Postponed to Q2 of 2023  | -                            | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 16,000 (Q2 of 2023)                | TCRF                        | Postponed to Q2/2023                               |
| 5   | KRA 1-3 | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Attachment of forecasters from TC Members to RSMC Tokyo | nil                | Provision of administrative and logistic support. | Q1 of 2023 (11-13 Jan 2023)  | RSMC Tokyo, WMO              | Assessment as given in RSMC Tokyo report.   | USD 11,000*                            | TCTF and Member self-funded | Yes (conducted online)                             |

\* Required funding not used as the attachment trainings in Jan 2022 and 2023 were conducted online due to COVID-19.

## TRCG Work Plan for 2022 – 2023 (including Q1 of 2024)

| Year | Quarter | Typhoon Committee Activity                   | Training and Research Activities (*activities organized by parties other than TRCG) | Themes (if any) / Remarks   |     |
|------|---------|--|---|---|-----|
| 2022 | Q1      | TC-54<br>(Video conferencing)                | RSMC Tokyo Attachment Training  | 11 – 13 January (Online)  |     |
|      |         |  | Research Fellowship   | HKO fellowship (Online)   |     |
|      | Q2      |  | Research Fellowship   | KMA and STI fellowships were cancelled                              |     |
|      | Q3      |  |   |   |     |
|      | Q4      | 17 <sup>th</sup> IWS<br>(Video conferencing) | ** <i>Typhoon Forecasting Techniques Workshop under PPI of WGM AOP 2022</i>         | ** 11-13 October 2022 (hybrid) hosted by Met Malaysia               |     |
|      |         |  | 4 <sup>th</sup> TRCG Forum / TRCG Planning Meeting                                  | Postponed to Q4 2023 in conjunction with 18 <sup>th</sup> IWS       |     |
|      |         |  | Roving Seminar  | Postponed to Q2 2023 in Vietnam                                     |     |
|      |         |  | CMA Training Programme  | 24 October – 4 November 2022 (Online)                               |     |
| 2023 | Q1      | TC-55<br>(Video conferencing)                | RSMC Tokyo Attachment Training  | 11 – 13 January (Online)  |     |
|      |         |  | Research Fellowship   | HKO fellowship in Jan-Mar   |     |
|      | Q2      |  | Roving Seminar  | Proposed theme: “Impact based forecasting”                          |     |
|      |         |  | Research Fellowship   | Fellowship or attachment visit(s) hosted by KMA, STI and/or AP-TCRC |     |
|      | Q4      | 18 <sup>th</sup> IWS<br>(TBC)                | 4 <sup>th</sup> TRCG Forum / TRCG Planning Meeting                                  | Proposed theme: “Towards a typhoon resilient society”               |     |
|      |         |  | CMA Training Programme  | TBC   |     |
|      | 2024    | Q1   | TC-56   | RSMC Tokyo Attachment Training                                      | TBC |

| Training and Research Coordination Group (TRCG) Annual Operating Plan 2023 (including Q1 of 2024) |         |  |  |                    |   |                            |                              |   |  |                             |
|---|---------|--|--|--------------------|---|----------------------------|------------------------------|---|--|-----------------------------|
| Objective Number  | KRAs    | Objective  | Action   | Other WGs Involved | TCS Responsibility                                | Expected Quarter Completed | Other Organizations Involved | Success Indicators  | Funding Required                       | Funding Sources             |
| 1   | KRA 1-3 | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Attachment of forecasters from TC Members to RSMC Tokyo  | nil                | Provision of administrative and logistic support. | Q1<br>(11-13 Jan 2023)     | RSMC Tokyo, WMO              | Assessment as given in RSMC Tokyo report.   | USD 11,000*                            | TCTF and Member self-funded |
| 2   | KRA 1-3 | To facilitate technology transfer among TC Members through research and development initiatives.   | Research Fellowship  | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q1-Q3                      | TC Members                   | Publication of research findings and development output in TCRR or other journals.      | Fellowship offered by voluntary hosts. | TC Members                  |
| 3   | KRA 1-3 | To: (a) implement training initiatives in the priority operational and research areas as identified in the TRCG annual report; and (b) enhance Members' capability and capacity in the assessment of damage and pre-assessment of potential impact caused by landfalling TCs | Roving Seminar<br><br>[Impact based forecasting]   | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q2                         | -                            | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 16,000                             | TCTF                        |
| 4   | KRA1-3  | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Up to 4 forecasters from TC to CMA Forecaster Training   | nil                | Provision of administrative and logistic support. | Q3-Q4                      | CMA                          | Assessment as given in CMA report.  | Participation will be supported by CMA | CMA                         |
| 5   | KRA 1-3 | To: (a) implement training initiatives in the priority operational and research areas as identified in the TRCG annual report; and (b) enhance Members' capability and capacity in the assessment of damage and pre-assessment of potential impact caused by landfalling TCs | 4 <sup>th</sup> TRCG Forum<br>[Towards a typhoon resilient society]<br><br>TRCG Planning Meeting<br>(in conjunction with the 18 <sup>th</sup> IWS) | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4                         | -                            | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 26,000                             | TCTF                        |
| 6   | KRA 1-3 | To enhance TC Members' capacity and knowledge in operational tropical cyclone forecasting.   | Attachment of forecasters from TC Members to RSMC Tokyo  | nil                | Provision of administrative and logistic support. | Q1 of 2024                 | RSMC Tokyo, WMO              | Assessment as given in RSMC Tokyo report.   | USD 11,000                             | TCTF and Member self-funded |

\*The RSMC Tokyo Training in Jan 2023 was conducted online due to the COVID-19 pandemic.