**APPENDIX XII**

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

**Annual Report 2024**

Anh Tien DO (TRCG Chair)

Vietnam

**1. Introduction**

* 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 (as of 13 February 2025) are:

Chair: Dr Anh Tien DO (Vietnam)

Vice Chair: Dr Eun Jeong CHA (Republic of Korea)

Mr CHOY Chun-wing (Hong Kong, China)

Members: Mr So Im Monichoth (Cambodia)

Dr QIAN Qifeng (China)

Mr SONG Yong Choi (DPR Korea)

Dr ISHIHARA Koji (Japan)

Dr SHIMADA Udai (Japan)

Dr Mayphou Mahachaleun (Lao PDR)

Mr HO Kuok Hou (Macao, China)

Dr Fariza binti Yunus (Malaysia)

Ms Shirley David (Philippines)

Ms Kyungho Lee (Republic of Korea)

Mr Eugene Chong (Singapore)

Ms Sotharat Insawang (Thailand)

Mr Eric Lau (USA)

**3. Major TRCG Activities in 2024**

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

3.1 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.

3.2 The Typhoon Committee Roving Seminar 2024 was successfully held on 17 – 19 December 2024 in Bangkok of Thailand. The seminar was kindly hosted by the Thai Meteorological Department (TMD). The theme of this seminar was on “Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response” with speakers of the seminar as follows:

|  |  |
| --- | --- |
| Topic | Speaker |
| 1. Introduction to Artificial Intelligence | Professor Dr. Chidchanok Lursinsap  Chulalongkorn University, Thailand |
| 2. Machine Learning Algorithms for Prediction | Professor Dr. Chidchanok Lursinsap Chulalongkorn University, Thailand |
| 3. AI Tools and Platforms for Tropical Cyclone Prediction | Associate Professor Dr. Chanh Kieu  Indiana University, Bloomington, USA |
| 4. AI in Meteorological Data Analysis | Associate Professor Dr. Chanh Kieu  Indiana University, Bloomington, USA |
| 5. AI-driven Weather Forecasting at National Meteorological Center of CMA | Dr. ZHOU Kanghui,  China Meteorological Administration (online) |
| 6. AI-powered Hydrological Modeling for Operational Flood Forecasting | Dr. MIYAMOTO Mamoru  WGH Typhoon Committee from International Centre for Water Hazard and Risk Management (ICHARM) |
| 7. Fast Storm Detection and Flood Simulation Using Hard Computing and AI Approach | Assistant Professor Dr. Somporn Chuai-Aree  Prince of Songkla University, Pattani Campus, Thailand |
| 8. Household Level Disaster Risk Assessment and a Smartphone-based Pin-point Alert System to Save Lives from Typhoon-related Disasters | Prof. ONO Yuichi  Tohoku University, Japan |
| 9. The application and performance of AI-based global weather forecasting models in typhoon | Mr. Nie Gaozhen,  China Meteorological Administration (online) |

A group of people standing in front of a screen

AI-generated content may be incorrect.Figure 1. Roving Seminar 2024: Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response (17 – 19 December 2024, Bangkok, Thailand)

3.3 The seminar was attended by 82 participants from China (4); Hong Kong, China (10); Japan (2); Lao PDR (1); Macao, China (5); Malaysia (3); Philippines (1); Thailand (46); Viet Nam (1) and India (9) . Seven resource persons came from China (2); Japan (2); Thailand (2) and USA (1) and one representative came from the Typhoon Committee Secretariat (TCS). The participants considered that the lectures and advice provided by the speakers are useful. They also gained knowledge and ideas how to apply AI on their tropical cyclone forecasting in the future. A summary report of the seminar can be found in Annex II.

***Forecasters’ Training Attachment***

3.4 The RSMC Tokyo successfully hosted its Attachment Training course on operational tropical cyclone forecasting from 14 to 23 January 2025. The Regional Specialized Meteorological Centre (RSMC) Tokyo - Typhoon Center has organized ESCAP/WMO Typhoon Committee Attachment Training courses annually since 2001 with the support of the WMO Tropical Cyclone Programme and the Typhoon Committee in order to advance the tropical cyclone (TC) analysis and forecasting capacity of the Typhoon Committee Members. The course has been set out under Category 2 Unit of the Tropical Cyclone Forecast Competency given in the Typhoon Committee Region specifications in the Typhoon Committee Operational Manual (TOM). Seven forecasters from China, Hong Kong, China, Lao PDR, the Philippines, Republic of Korea, Thailand and Vietnam in the Typhoon Committee as well as four forecasters from Bangladesh, Maldives, Oman and Pakistan in the Panel on Tropical Cyclone attended the training. In this training, not only researchers but also Japanese experts from the Typhoon Committee’s Hydro and Disaster Risk Reduction group were invited as lecturers, with the expectation that the training would give forecasters a broader perspective and contribute to the UN's EW4ALL initiative.

 Figure 2. RSMC Tokyo Attachment Training in 2025 (14-23 January 2025, Tokyo, Japan)

3.5 CMA’s Typhoon Forecaster Training Programme, namely the 2024 International Training Course on Tropical Cyclone Monitoring and Forecasting Operation and Advanced Management, has been successfully conducted at the Guangdong-Hong Kong-Macao sub-center of the World Meteorological Center Beijing, Guangzhou, China on 25 November – 5 December 2024. A total of 35 participants from over 33 countries and regions joined the training workshop, including 6 trainees from TC. The course covers China's practice of meteorological disaster prevention and reduction, the latest strategic development initiatives of WMO, China's practice of meteorological disaster prevention and reduction, monitoring, forecasting and early warning of tropical cyclones, and other related topics. The training workshop and programme design were well appreciated by the participants, most of them reflected that the training materials are highly useful and practical for operational applications.

A group of people posing for a photo

AI-generated content may be incorrect.Figure 3. CMA’s Typhoon Forecaster Training Programme (25 November – 5 December 2024, Guangzhou, China)

***Research Fellowship Scheme***

3.6 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.

3.7 Hong Kong, China offered a fellowship research project in Q1 2024 on the topic entitled “A study on analogue forecasting for track and intensity of tropical cyclones using deep-learning techniques”. A research fellow from Thai Meteorological Department (TMD) joined the fellowship programme. The fellow had shown a proof of concept that the model in the enhanced AFS system can be further fine-tuned for purpose of analogue forecasting for TC tracks. Hong Kong, China will host a fellowship research project in Q1 2025 on the topic entitled “Deep Learning Model of Tropical Cyclone Rainfall Nowcasting Using Satellite and Radar Data”. The fellowship has been awarded to two research fellows from TMD and Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

3.8 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 III. Publications and papers published in connection with the scheme are listed in Annex IV.

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

3.9 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 and related logistical arrangement. Updates on the development of attachment programme were presented at the 17th IWS. Draft documents of the attachment visits including the application / nomination procedures and selection criteria, etc., would be available from AP-TCRC for seeking comments from TRCG and other WGs, and for reporting at TC55 about the progress. Discussions on Time-bound Pilot Project between AP-TCRC and TRCG were conducted. The research topic “Understanding of rapid intensification mechanism of tropical cyclone and influence of climate change” was included in the “Priority Funding Missions for 2023” of the International Tropical Cyclone Collaborative Research Guide (2023-2025). Under this project, Prof. Porpattama Hammachukiattikul of Thailand, Dr. Ayesha Kanwal of Pakistan Meteorological Department, and Dr. Wahiduzzaman MD. of Australia as well as Dr. Alea Yeasmin of Australia visited AP-TCRC engaged in this project. Three research teams have been established, each comprising internationally-acclaimed meteorologists: Typhoon Scientific Experiments, Digital Typhoon Technology, and Typhoon Disaster Prevention Strategies, along with a comprehensive management office team. These three teams together with several research institutions, carried out the field experiment on the impact of typhoons on coastal megacities for the first time in China. On the basis of the experiment, the typhoon modeling and digital application for coastal megacities were explored. Other studies on typhoon climate have also been conducted, and results have been published in several international journals.

3.10 The 1st AP-TCRC Forum was held in conjunction with the 19th Integrated Workshop (19th IWS) in Shanghai, China on November 19, 2024. The main theme of the 1st AP-TCRC Forum is “Embracing New Technologies for Achieving Early Warnings for All". Over 100 international experts convened to discuss the evolving characteristics of typhoon hazards in the Asia-Pacific and beyond, advancements in observation and forecasting technologies, and innovative strategies for managing typhoon risks across different nations.

A group of people posing for a photo

AI-generated content may be incorrect.

Figure 4. The 1st AP-TCRC Forum in Shanghai, China on November 19, 2024.

**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 V.

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.

4.3 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.

4.4 An intermediate course was started in 2018 and is offered as a supplemental, more in-depth course for returning students. This allows 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. The PITD curriculum includes introductory and intermediate weather analysis and forecasting topics, as well as communications systems training. The PITD programs include partners such as NOAA National Weather Service-Pacific Region, City and County of Honolulu Emergency Management, Joint Typhoon Warning Center, UH School of Ocean and Earth Science and Technology, and KHON2. In 2024, PITD hosted a smaller group of participants, but from smaller met services we hadn't served in a while. There were two (2) cohorts, both Level 1. (Cook Islands - 2 students, Kiribati - 2 students, Nauru - 1 student, Tokelau - 2 students, Tuvalu - 1 student). In 2025, three (3) intermediate courses are planned.

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

5.1 Based on the discussion during the 4th TRCG Meeting held in conjunction with the 18th Integrated Workshop (IWS) in Bangkok, Thailand on 28 November – 1 December 2023. The priority and needs for training and research activities have been reviewed by TRCG Members and updated as follows:

***(A) Meteorology***

*Monitoring*

1. application of new technologies, especial artificial intelligence in TC analysis;
2. application of IoT in observation network;
3. application of Dvorak and microwave satellite image analysis techniques;
4. application of radar-based analysis/products for landfalling tropical cyclones and monsoon depressions; and
5. 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*

1. application of new technologies, especially artificial intelligence, in TC track and intensity forecasting;
2. development and enhancement of tropical cyclone analysis and forecast techniques from nowcast to medium range, and seasonal to long-range predictions;
3. development of tropical cyclone structure and intensity forecasting techniques such as rapid intensification and wind structure;
4. application of ensembles of guidance from global and regional dynamical models, ensemble prediction systems, conceptual models, statistical models and systematic knowledge-based approach;
5. use of high-resolution numerical models with advanced data assimilation techniques;
6. rainfall forecasting: development of nowcasting and very short range forecasting techniques, and understanding of interaction between tropical cyclones and monsoon;
7. development of probability forecasting and extended outlook;
8. development of impact-based forecast and risk-based warnings; and
9. better understanding of wave, storm surge and marine forecasting;

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

1. application of new technologies, especially artificial intelligence, for forecasting of river flooding and urban flash flood;
2. application of meteorological and hydrological information for forecasting of river flooding and urban flash flood; and
3. geological hazards associated with heavy rain and tropical cyclones such as flash flood, mudslides and landslides;

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

1. development of technical procedures to quantify forecast uncertainties and to convert probabilistic information into effective warnings;
2. development of decision-making tools for DRR purpose, including the integration of forecast information with GIS and the use of automated information processing systems;
3. making use of new communication technology; and
4. community response and outreach effort for mitigation of the societal impact caused by disasters.

***(D) Other Cross Cutting Topics***

1. 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;
2. 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;
3. effective communication of warning messages to stakeholders, DRR users and communities at risk; and
4. 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 Review of the TRCG AOP 2024 can be found in Annex VI.

6.2 The provisional TRCG work plan for 2024 to 2027/28 and Annual Operating Plan of 2025 are in Annex VII and VIII respectively. 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) have been incorporated in the TRCG’s work plan and Annual Operating Plan. The 3rd online meeting of International Science Steering Committee (ISSC) was held on 17 January. Prof. Johnny C.L. CHAN and Dr. Robert Fulton ROGERS, Science Director of AP-TCRC, reported the (1) 2024 Progresses; (2) International Tropical Cyclone Collaborative Research Guide (2023-2025); and (3) AP-TCRC Work Plan for 2025 and ISSC members discussed the 2025 work plan. The AP-TCRC plans Typhoon Structure and Intensity Change and Associated Impacts, Subseasonal, seasonal, and climate-scale prediction for landfalling typhoons, and Typhoon Early Warning multidisciplinary research in 2025. The provisional TRCG and AP-TCRC work plan for 2025 to 2026 and Annual Operating Plan of 2025 are in Annex VII and VIII respectively.

6.3 In accordance with the approval of at the 56th session of the Typhoon Committee, the 13 Members regularly attending the Roving Seminar are divided into three sub-regions: (1) China; DPR Korea; Hong Kong, China; Macao, China and Republic of Korea; (2) Cambodia; Philippines, U.S.A and Viet Nam; and (3) Lao PDR; Malaysia; Singapore and Thailand; and the seminars will normally be organized by rotation in the three sub-regions. Priority of TCTF support will be given to on-site participants from Members within the same sub-region (other than the host Member). This will help to minimize long travels and will provide more opportunities for local forecasters to attend. Consider the higher travel cost the TCTF budget will be adjusted for the year when U.S.A. hosts of the roving seminar to cater similar number of keynote lecturers and participants.

6.4 The initial theme of the roving seminar in the coming three years were also discussed during the TRCG planning meeting in November 2023. They are (1) Application of Artificial Intelligence/Machine Learning (AM/ML) in Tropical Cyclone forecasting and Warning; (2) Application of remote sensing technologies in operational tropical cyclone monitoring and forecasting and (3) Tropical cyclone related hazards (Storm Surge/flooding/landslides) and the application of big data/social media in weather warning services/emergency management. Thailand hosted the roving seminar in 2024 with the topic “Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response” which is the combination of the theme (1) and (3). Therefore, the proposed theme of the roving seminar 2025 could be the theme (2): Application of remote sensing technologies in operational tropical cyclone monitoring and forecasting. China expressed interests to host the roving seminar and proposes to host the Seminar in November or December 2025, in Guangzhou City, Guangdong Province, China.

6.5. 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.

6.6. 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, WGDRR, AP-TCRC and WMO Training Centre in Nanjing as well as various interested Members if the opportunity arises.

6.7 TRCG plans to organize a meeting in Q2 2025 to review and update the research and training priorities, discuss topics for upcoming roving seminars, assess progress on the AOP 2025, and address other relevant matters

***Annex I***

**Summary of Roving Seminars**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Dates** | **Venue** | **Topic** | **Lecturers** |
| 2003 | 20 – 21 Oct | Seoul | Interpretation of Typhoon Forecasts and Analyses | Dr. H-J Kwon  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  Dr. P.W. Li  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  Dr. P.W. Li |
| 2004 | 22 – 24 Nov | Beijing | Operational Application of Multi-model Ensemble Typhoon Forecasts | Prof. Johnny C.L. Chan  Mr. MANNOJI Nobutaka |
| 25 – 27 Nov | Kuala Lumpur | Operational Application of Multi-Model Ensemble Typhoon Forecasts | Prof. Johnny C.L. Chan  Mr. MANNOJI Nobutaka |
| 2006 | 4 – 7 Sep | Ha Noi | Tropical Cyclone Motion and Intensity, and Principles of Dvorak Method | Prof. Johnny C.L. Chan  Mr. Joe Courtney  Dr. B.-J. Kim |
| 2007 | 5 – 8 Sep | Manila | Satellite and Radar Analysis Techniques, and Tropical Cyclone Interaction withMonsoon Systems | Mr. Roger Edson  Mr. Bart Hagemeyer  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  Mr. Chip Guard  Mr. Sam Muchemi |
| 2010 | 30 Nov – 3 Dec | Ubon Ratchathani | Tropical Cyclone Genesis and Large Scale Interaction | Mr. S.M. Lee  Prof. Zhang Qinghong  Dr. Mark Lander |
| 2011 | 20 – 23 Sep | Petaling Jaya | Heavy Rain and Flood Hazards associated with Landfalling Tropical Cyclones | Dr. Siriluk Chumchean  Mr. H.Y. Yeung  Prof. Chen Charng-Ning |
| 2012 | 30 Oct – 1 Nov | Seoul | Tropical Cyclone Damage Assessment and Impact Forecast | DRR experts from NDMI  Ms. Xu Jing  Mr. W.K. Wong |
| 2014 | 3-5 Nov | Hong Kong | Warning communication | Mr. Chip Guard  Mr. Ahmed Nadeem  Ms. Sandy, M.K. Song  Mr. K.L. Lee |
| 2015 | 4-6 Nov | Lao PDR | Flash flood and landslides | Mr NAGAI Yoshiki  Prof. Xu-dong Fu  Dr. Dong-ryul Lee |
| 2016 | 15-17 Nov | Viet Nam | Storm Surge | Mr. KOHNO Nadao  Mr. Author Taylor  Mr. Dickson Lau |
| 2018 | 20-22 Nov | Singapore | Application of Remote Sensing Technologies | Mr. YAMASHITA Koji  Dr. Xiang Fang  Mr. Ray Kong |
| 2019 | 11-13 Nov | China | Quantitative precipitation estimation and forecasting (QPE/QPF) | Mr. W C Woo  Mr. Erik Beaker  Prof. NAKAKITA Eiichi |
| 2023 | 28-30 Jun | Ha Noi, Viet Nam | Advances in Tropical Cyclone Monitoring and Prediction for Impact based  forecasting | Assoc. Prof. Dr. Pham Thi Thanh Nga  Dr. Zifeng Yu  Prof. Dong In Lee  Dr. Chail Park  Dr. Hoang Phuc Lam  Dr. Craig Earl-Spurr  Prof. Kosuke Ito  Dr. Senaka Basnayake  Mr. Nadao Kohno |
| 2024 | 17-19 Dec | Bangkok, Thailand | Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response | Prof. Dr. Chidchanok Lursinsap  Assoc. Prof. Dr. Chanh Kieu  Dr. ZHOU Kanghui  Dr. MIYAMOTO Mamoru  Assistant Prof. Dr. Somporn Chuai-Aree  Prof. ONO Yuichi  Mr. Nie Gaozhen |

***Annex II***

**Report of Roving Seminar**

**SUMMARY OF TYPHOON COMMITTEE ROVING SEMINAR 2024**

**(Bangkok, Thailand, 17 – 19 December 2024)**

**I. Organization**

1. The Typhoon Committee Roving Seminar (TCRS) 2024 with the theme “Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response” was successfully held in hybrid mode on 17 – 19 December 2024 in Bangkok, Thailand. It was organized by ESCAP/WMO Typhoon Committee (TC) and hosted by the Thai Meteorological Department (TMD).

2. The Seminar was attended by 82 participants from China (4); Hong Kong, China (10); Japan (2); Lao PDR (1); Macao, China (5); Malaysia (3); Philippines (1); Thailand (46); Viet Nam (1) and India (9). Seven resource persons came from China (2); Japan (2); Thailand (2) and USA (1) and one representative came from the Typhoon Committee Secretariat (TCS). The list of participants is given in Attachment A.

**II. Opening**

1. The representative of TMD, Dr. Wattana Kanbua, Director of Meteorological Development Division on behalf of the Chair of Local Organizing Committee gave a warm welcome and reported the numbers of the on-site and online participants attending the Roving Seminar 2024.

2. The representative of TCS, Mr. Clarence Fong in his address expressed his gratitude to Thailand for hosting the Roving Seminar as it was one of the main activities of the TC, coordinated by the TRCG since 2003. The goal of the seminar is to encourage members of the TC to share expertise and engage in capacity-building activities such as tropical cyclone analysis, forecast and warning as well as the effects of associated hazards. He also expressed his gratitude to Thailand government, TMD and the Local Organizing Committee for hosting the Roving Seminar. He further thanked all of the speakers to share their valuable expertise on the artificial intelligence for enhanced tropical cyclone prediction and emergency response.

3. The Roving Seminar 2024 was officiated by Dr. Sugunyanee Yavinchan, Director-General of TMD. She delivered the opening speech, extending warm welcome to the participants and lecturers attending the Seminar in person and online. She extended her gratitude to the Training and Research Coordination Group (TRCG) under the Typhoon Committee, as well as the Typhoon Committee Secretariat (TCS), for their invaluable assistance and financial support in organizing the Roving Seminar 2024. She hoped that this capacity-building initiative will provide significant advantages to all participants, strengthen collaboration among the members of the Typhoon Committee and the Panel on Tropical Cyclones, and contribute to the implementation of the "Early Warning for All."

**III. Seminar Programme**

1. There were 3 days in the Seminar Programme. On Day 1, there were three lectures. Professor Dr. Chidchanok Lursinsap from Chulalongkorn University, Thailand delivered two lectures on “Introduction to Artificial Intelligence” and “Machine Learning Algorithms for Prediction”.
2. Associate Professor Dr. Chanh Kieu from Indiana University, Bloomington, USA delivered a lecture on “AI Tools and Platforms for Tropical Cyclone Prediction”.
3. Six on-site participants from China; Hong Kong, China; Lao PDR; Philippines; Thailand and Vietnam reported and shared their experiences on the use of AI, Numerical Weather Prediction (NWP), and tropical cyclone monitoring and prediction in their organizations.
4. On Day 2, there were four lectures. Associate Professor Dr. Chanh Kieu from Indiana University, Bloomington, USA delivered a lecture on “AI in Meteorological Data Analysis”.
5. Dr. ZHOU Kanghui from China Meteorological Administration (CMA), delivered an online lecture on “AI-driven Weather Forecasting at National Meteorological Center of CMA”.
6. Dr. MIYAMOTO Mamoru, Chairperson, WGH Typhoon Committee from International Centre for Water Hazard and Risk Management (ICHARM) delivered a lecture on “AI-powered Hydrological Modeling for Operational Flood Forecasting”.
7. Assistant Professor Dr. Somporn Chuai-Aree from Prince of Songkla University, Pattani Campus, Thailand delivered a lecture on “Fast Storm Detection and Flood Simulation Using Hard Computing and AI Approach”.
8. On Day 3, there were two lectures. Prof. ONO Yuichi, Tohoku University, Japan delivered a lecture on “Household Level Disaster Risk Assessment and a Smartphone-based Pin-point Alert System to Save Lives from Typhoon-related Disasters”.
9. Mr. Nie Gaozhen, National Meteorological Center, CMA delivered an online lecture on “The application and performance of AI-based global weather forecasting models in typhoon”.
10. Technical visits to the Thai Meteorological Department Headquarters were conducted in the afternoon of 19 December 2024.
11. The Roving Seminar Programme is given in Attachment B.

**IV. Proposals and Recommendations**

1. The participants gave a warm appreciation to the seven resource persons for their presentations and useful advice as well as examples of good practices on the relevant topics.
2. Dr. Eun Jeong CHA, Co-Vice Chairpersons of TRCG (Training and Research Coordination Group), summarized that the roving seminar is very informative and useful for tropical cyclone forecast and research group and hoped all participants will apply the AI techniques derived from the seminar to their work. The feedbacks and recommendations collated from the participants are summarized in Attachment C.
3. Suggestions from the resource persons and organizers for future reference:
4. Discussion when PDE (Partial Differential Equation) models versus AI approach wins as well as the constraints of both approaches.
5. Would love to hear more about how regional centers deploying/developing AI models for TC forecast.
6. Integrating GIS data and risk map for online accessing application for whole Asian.
7. Running the open source well-trained data-driven weather forecasting models, such as Pangu, Graphcast, Gencast, etc., will be feasible and helpful.

**V. Closing**

1. The resource persons and participants expressed their gratitude to the TMD for hosting this seminar and for the warm hospitality.
2. Mr. Thanasith Iamananchai, Deputy Director-General (TMD), Dr. Wattana Kanbua, Director of Meteorological Development Division (TMD), Assistant Professor Dr. Somporn Chuai-Aree, Associate Professor Dr. Chanh Kieu, Dr. MIYAMOTO Mamoru, Prof. ONO Yuichi, and Mr. Clarence Fong, Representative from TCS presented the attendance certificates to the on-site participants.
3. The Roving Seminar was closed on 19 December 2024.

*Attachment A*

**List of Participants of the Typhoon Committee Roving Seminar 2024**

(**Bangkok, Thailand, 17 – 19 December 2024)**

|  |  |
| --- | --- |
| **Members** | **Name of Participants** |
| China | Mr. Niu Zeyi  Dr. Huang Xiaoyan (online)  Ms. Pan Ning (online)  Dr. Teng Daigao (online) |
| Hong Kong, China | Dr. Chow Wang  Dr. Cheng Chung-choi (online)  Mr. Cheung Chun Ngai (online)  Mr. Cheung On Pong (online)  Mr. Kok Mang-hin, Macro (online)  Mr. Lee Sung-ho (online)  Mr. Leung Ka Fai (online)  Ms. Leung Yan Yu Christy (online)  Dr. Tam Hiu Ching (online)  Ms. Tse Shuk-mei (online) |
| Japan | Mr. Masaaki Ikegami (online)  Dr. Yamaguchi Munehiko (online) |
| Lao PDR | Ms. Phetlasy Somchanmavong |
| Macao, China | Mr. Fong Kin Sio (online)  Mr. Ho Kuok Hou (online)  Mr. Lao Hou Lun (online)  Mr. Lei Heng-Wai (online)  Ms. Leong Un Kei (online) |
| Malaysia | Mr. Mohd Hazril Zamberi (online)  Mr. Johnson Soumin (online)  Mr. Abdul Aizat Nazmi A Azmi (online) |
| Philippines | Ms. Jehan FE Serrano Panti |
| Thailand | Mr. Somprat Srithagon  Mr. Olan Naowkraisorn  Mr. Wuttisak Ratinonsakul  Mr. Chatchai Chaiyasaen  Mr. Nuthakit Singhaphet  Ms. Pantaree Nongnut  Mr. Peeranat Longsombun  Mr. Fatah Masthawee  Ms. Kamolrat Saringkarnphasit  Mr. Pattara Sukthawee  Mr. Abhisorn Nathong  Ms. Nichanun Trachow  Mr. Attasit Phakam  Ms. Ariya Chanmanin  Mr. Pakornpop Boonyuen  Mr. Charkrit Thongbai  Mr. Wirachart promta  Mr. Tharakorn Jamvitheelerd (online)  Mr. Pongkhun Maneesri (online)  Ms. Paweena​ Panikodom (online)  Ms. Plaidao Khumchaiyaphum (online)  Mr. Watchara Thintalang (online)  Mr. Narathep Sakunnithimetha (online)  Mr. Putchaphan Sirisap (online)  Mr. Veerawat Limsurat (online)  Ms. Pattraporn Teeraket (online)  Ms. Kullanit Suebvisai (online)  Ms. Sasithron Maynasin (online)  Ms. Araya Chinnawong (online)  Ms. Chanattha Saengrattanayon (online)  Ms. Theeraluk Pianmana (online)  Ms. Watcharaporn Moonsap (online)  Mr. Wira Samalee (online)  Mr. Kriangsak Thaijai-un (online)  Mr. Peeradech Suykradueng (online)  Ms. Chuanpit Ngernchalad (online)  Mr. Raksapol Porchit (online)  Mr. Visit Seesutuem (online)  Mr. Aphinya Chitchaeng (online)  Mr. Kritsakorn Pothaworn (online)  Ms. Nalinee Kosasang (online)  Mr. Tanintorn​ Thuekhunthot​ (online)  Mr. Uchukorn​ Phimsin (online)  Ms. Phiraya Lueangsophaphan (online)  Mr. Pachapon Kampeera (online)  Mr. Yutthaphong Sawaengwong (online) |
| Viet Nam | Mr. Tran Anh Duc |
| India | Dr. Amit Bhardwaj (online)  Dr. BUSHAIR M.T (online)  Bibraj Raj (online)  S.Prayek (online)  Dr. S. D. Sanap (online)  Ms. Monica Sharma (online)  Dt. Arulalan Thanigachalam (online)  Dr. Dushmanta Ranjan Pattanaik (online)  Dr. V.Reval Durai (online) |

|  |  |
| --- | --- |
| Resource persons | Professor Dr. Chidchanok Lursinsap  Associate Professor Dr. Chanh Kieu  Dr. ZHOU Kanghui (online)  Dr. MIYAMOTO Mamoru  Assistant Professor Dr. Somporn Chuai-Aree  Prof. ONO Yuichi  Mr. Nie Gaozhen (online) |
| TCS | Mr. Clarence Fong |
| TRCG/TCS | Dr. Eun Jeong CHA, Co-Vice Chair(online) |

*Attachment B*

**Typhoon Committee Roving Seminar 2024**

**Seminar Programme**

**Dates and Venue:** 17 – 19 Dec. 2024, Novotel Bangkok Bangna, Bangkok, Thailand

**Theme:** Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response

|  |  |  |
| --- | --- | --- |
| **Time** | **Content** |  |
| **Day 1, Tuesday, 17 December 2024** | | |
| 08:30-09:00 | Registration | Organizing Committee |
| 09:00-10:00 | Opening Workshop   1. Welcome speech, Dr. Wattana Kanbua, Director of Meteorological Development Division, TMD 2. Mr. Clarence Fong, Typhoon Committee Secretariat (TCS) 3. Opening Message by Dr. Sugunyanee Yavinchan, Director-General, TMD | Organizing Committee |
| Group photo | All participants |
| 10:00-10:30 | Break |  |
| 10:30-12:00 | **Introduction to Artificial Intelligence**   1. Basics of AI and Machine Learning 2. Overview of AI applications in meteorology | Professor Dr. Chidchanok Lursinsap |
| 12:00-13:30 | Lunch |  |
| 13:30-15:00 | **Machine Learning Algorithms for Prediction**   1. Supervised and unsupervised learning techniques 2. Introduction to neural networks and deep learning 3. Case studies on prediction models | Professor Dr. Chidchanok Lursinsap |
| 15:00-15:20 | Break |  |
| 15:**2**0-16:**0**0 | **AI Tools and Platforms for Tropical Cyclone Prediction**   1. Overview of popular AI tools and platforms (TensorFlow, Keras, PyTorch, etc.) 2. Data visualization and interpretation | Associate Professor Dr. Chanh Kieu |
| 16:00-17:00 | Report and experience sharing by the participants   1. China 2. Hong Kong, China 3. Lao PDR 4. Philippines 5. Thailand 6. Vietnam | All participants |
| **Day 2, Wednesday, December 1**8**, 2024** | | |
| 09:00-10:20 | **AI in Meteorological Data Analysis**   1. Data collection and preprocessing 2. Feature selection and engineering 3. Techniques for handling large datasets | Associate Professor Dr. Chanh Kieu |
| 10:20-10:40 | Break |  |
| 10:40-12:00 | **AI-driven Weather Forecasting at National Meteorological Center of CMA** | Dr. ZHOU Kanghui,  China Meteorological Administration (online) |
| 12:00-13:30 | Lunch |  |
| 13:30-14:50 | **AI-powered Hydrological Modeling for Operational Flood Forecasting** | Dr. MIYAMOTO Mamoru |
| 14:50-15:10 | Break |  |
| 15:10-16:40 | **Fast Storm Detection and Flood Simulation Using Hard Computing and AI Approach** | Assistant Professor Dr. Somporn Chuai-Aree |
| **Day 3, Thursday, December 19, 2024** | | |
| 09:00-10:20 | **Household Level Disaster Risk Assessment and a Smartphone-based Pin-point Alert System to Save Lives from Typhoon-related Disasters** | Prof. ONO Yuichi  Tohoku University, Japan |
| 10:20-10:40 | Break |  |
| 10:40-11:40 | **The application and performance of AI-based global weather forecasting models in typhoon** | Mr. Nie Gaozhen,  China Meteorological Administration **(**online) |
| 11:40-11:50 | Quiz | All participants |
| 11:50-12:00 | Evaluation of the Seminar | All participants and Lecturers |
| 12:00-12:15 | Presentation of Certificates | All participants |
| 12:15-**12**:30 | Summary and Closing  1. TRCG’s representative, Dr. Eun Jeong CHA, Co-Vice Chair(online)  2. Mr. Thanasith Iamananchai, Deputy Director-General, TMD |  |
| 12:30-13:30 | Lunch |  |
| 1**4**:**0**0-16:00 | Technical Visit at TMD Headquarters | All participants |

*Attachment C*

**TRCG ACTIVITIES EVALUATION FORM**

Roving Seminar 2024

(Bangkok, Thailand, 17 – 19 Dec 2024)

**51 responses (out of 45 participants + 6 lecturers)**

**(not all questions answered by responders)**

**Part A: Event Logistics**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Expectation levels as indicated number of responders* | | | | | Below expectation | | Met Expectation | | Exceeded expectation | | no response | |
|  |
| (*P = participants; R = resource persons*) | | | | | P | R | P | R | P | R | P | R |  |
| 1. Overall administration/organization | | | | | 0 | 0 | 8 | 3 | 9 | 3 | 0 | 0 |  |
| 2. Pre-event arrangement and liaison | | | | | 0 | 0 | 4 | 2 | 12 | 4 | 1 | 0 |  |
| 3. Venue facilities | | | | | 0 | 1 | 7 | 2 | 10 | 3 | 0 | 0 |  |
| 4. Information announcements and instructions | | | | | 0 | 0 | 3 | 3 | 14 | 3 | 0 | 0 |  |
| 5. Travel arrangements | | | | | 0 | 1 | 6 | 2 | 11 | 2 | 0 | 1 |  |
| 6. Funding arrangements | | | | | 0 | 0 | 6 | 3 | 10 | 2 | 1 | 1 |  |
| 7. Accommodation | | | | | 0 | 0 | 6 | 2 | 11 | 3 | 0 | 1 |  |
| 8. Refreshments | | | | | 2 | 0 | 5 | 2 | 10 | 3 | 0 | 1 |  |
| 9. Social events and visitors' information | | | | | 0 | 0 | 5 | 2 | 11 | 3 | 1 | 1 |  |
| 10. Helpfulness and friendliness of organizers | | | | | 0 | 0 | 3 | 2 | 13 | 4 | 1 | 0 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Specific points for improvement, if any:** | | | | | |  |  |  |  |  |  |  |  |
| Cannot find any further improvement. Superb organization. | | | | | | | | | | | | |  |
| It was indeed a very informative yet friendly workshop. I hope to have a chance to participate more in the future. | | | | | | | | | | | | |  |
| Keep going for good collaboration. | | | | | | | | | | | | |  |
| The internet connection needs to be improved. Poor connections effected the online lectures. | | | | | | | | | | | | |  |
|  | | | | | | | | | | | | |  |

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**Part B: Technical Contents (from participants only)**

|  |  |
| --- | --- |
|  |  |

A chart of bar graph

AI-generated content may be incorrect.

**Part 1:**

Interest in Topic: 1=disinterested, 5=most interested

Topic Contents: 1=irrelevant, 5=most relevant

Topic Organization: 1=loosely structured, 5=well-structured

Lecture/Workshop Presentation: 1=poor, 5=excellent

Training or Practical Material: 1=ill-prepared, 5=well-prepared

Language: 1=hard to understand, 5=easy to follow

Effectiveness: 1=little understanding gained,

5=much understanding gained

**A chart of a graph

AI-generated content may be incorrect.**

**Part 2:**

Objectives and Scope: L = too narrow; M = just right; R = too wide

Emphasis: L = too theoretical; M = just right; R = too practical

Length: L = too short; M = just right; R = too long

Technical Level: L = too elementary; M = just right; R = too difficult

**Lectures:**

1. Introduction to Artificial Intelligence *by Professor Dr. Chidchanok Lursinsap*
2. Machine Learning Algorithms for Prediction *by Professor Dr. Chidchanok Lursinsap*
3. AI Tools and Platforms for Tropical Cyclone Prediction *by Associate Professor. Dr. Chanh Kieu*
4. AI in Meteorological Data Analysis *by Associate Professor. Dr. Chanh Kieu*
5. AI-driven Weather Forecasting at National Meteorological Center of CMA *by Dr. ZHOU Kanghui*
6. AI-powered Hydrological Modeling for Operational Flood Forecasting *by Dr. MIYAMOTO Mamoru*
7. Fast Storm Detection and Flood Simulation Using Hard Computing and AI Approach *by Assist. Prof. Dr. Somporn Chuai-Aree*
8. Household Level Disaster Risk Assessment and a Smartphone-based Pin-point Alert System to Save Lives from Typhoon-related Disasters *by Prof. ONO Yuichi*
9. The application and performance of AI-based global weather forecasting models in typhoon *by Mr. Nie Gaozhen*

**Part C: Follow-ups**

1. What operational benefits (new ideas, skills or methodology) you think would be gained from your experience in the event?

|  |
| --- |
| * Additional field of knowledge of machine learning to improve capabilities of NHMS * Discovering how AI can be used to analyze satellite imagery, social media data, and other sources to quickly assess the extent of damage after a TC makes landfall, enabling more efficient deployment of resources. * Apply AI for forecast TC and TC track * New knowledge about AI forecasting in the future. * Get a good understanding of the requirements to design an AI model and limitations of it * The experience shared by the speakers would be useful in developing operational products in the future * Get a lot of ideas from the research of the lecturers in ROVING 2024, especially the published works from CMA. |

1. Any foreseeable opportunity for operational implementation of the above benefits?  
     
   🞏 No foreseeable opportunity  
     
   🞏 Yes, benefits likely to be felt in about \_\_\_\_\_ years’ time.
2. a couple of years or less 3
3. in 2-4 years 4
4. in 4-6 years 2
5. no foreseeable opportunity 33

A group of people standing in front of a screen

AI-generated content may be incorrect.

Figure 5. The participants, lecturers and distinguished guests of the Roving Seminar took a group photo with the Director-General of Thai Meteorological Department,

Dr. Sugunyanee Yavinchan (the lady in purple dress, middle)

***A group of people holding signs

AI-generated content may be incorrect.***

Figure 6. The participants, lecturers and distinguished guests of the Roving Seminar

***Annex III***

**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  (China) | Hong Kong Observatory | 1 Feb – 31 Mar. 2001 |
| TC track forecasting with use of super-ensemble | Dr. PENG, Taoyong  (China) | Korea Meteorological Administration | 15 Jun – 15 Nov 2001 |
| Near real-time analysis of the wind structure of tropical cyclones | Dr. Nathaniel T. SERVANDO  (Philippines) | Hong Kong Observatory | 5 May – 4 Jul 2002 |
| Numerical modelling on typhoon intensity change | Ms. YU, Hui  (China) | Kongju National University and Korea Meteorological Administration | 15 Jul –15 Sep 2002 |
| Tropical cyclone track forecasting method | Dr. KANG, Bom Jin  Dr. KIM, Tae Jin  (DPR Korea) | Shanghai Typhoon Institute | Feb – Mar 2001  Oct – Nov 2002 |
| Analyses on the responses of extratropical transition of tropical cyclone to its environment | Dr. Vicente B. MALANO (Philippines) | Korea Meteorological Administration | Jun – Aug 2004 |
| Effect of tropical cyclone bogussing on model analysis and forecasts | Ms. WANG, Dongliang  (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. Sugunyanee YAVINCHAN  (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 (Philippines) | Hong Kong Observatory | 20 Sep – 19 Nov 2005 |
| Using ensemble prediction system (EPS) information in tropical cyclone forecasting | Ms. CHEN, Peiyan  (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  (Viet Nam) | Korea Meteorological Administration | Jun – Aug 2006 |
| Use of EPS information in TC forecasting | Mr. NGUYEN, Dang Quang  (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  (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  (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 KIRTSAENG (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 | 14Nov 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 KIRTSAENG (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)  Mr. Nguyen Tung Thanh (Vietnam)  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)  Mr. Aldczar D. Aurelio (The Philippines),  Mr. Jose Frivaldo, JR. (The Philippines),  Mr. Somprat Srithagon (Thailand), 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)  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)  Dr. Nguyen Dang Quang (Viet Nam) | Shanghai Typhoon Institute | 6-13 Dec 2015  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  - Typhoon genesis and analysis  - Typhoon track and intensity forecast  - TAPS\* operations and products | Benison Jay N. Estareja(The Philippines)  Boonthum Tanglumlead(Thailand)  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)  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  - Typhoon genesis and analysis  - Typhoon track and intensity forecast  - TAPS\* operations and products | Ms. Pensiri Trisataya and Ms. Chuanpit Ngernchalad (Thailand)  Mr. Robert B. Badrina (The Philippines)  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)  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)  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:  - Tropical meteorology & climatology  - Processing observed meteorological variables  - Typhoon analysis and monitoring-  - Producing typhoon information using TAPS and TOS  - Seasonal typhoon prediction | Mr. Nuthakit Singhaphet, (Thailand)  Mr. Tran Quang Nang, Typhoon (Viet Nam)  Dr. Guanbo Zhou (China)  Mr. Robb Prieto Gile (the Philippines) 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:  - Tropical meteorology & climatology  - Processing observed meteorological variables  - Typhoon analysis and monitoring-  - Producing typhoon information using TAPS and TOS  - Seasonal typhoon prediction | Ms. Reyes Sheilla Mae R. (the Philippines)  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)  Prof. Shishir Dube (India) | Shanghai Typhoon Institute | 24-29 March 2019  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 Xiaoqin LU (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 |
| Characteristics Analysis of Binary TC InteractionAnalysis of the Mechanism for Rapid Intensification | Mr. Jun Ezra M. Bulquerin (Philippines)  Mr. Somprat Srithagon (Thailand) | Korea Meteorological Administration | 11-24 June 2023 |
| Understanding of rapid intensification mechanismof tropical cyclone and influence ofclimatechange. | Prof. Porpattama Hammachukiattiku (Thailand) | AP-TCRC | 2023 |
| Study on analogue forecasting for  track and intensity of tropical  cyclones using deep learning techniques | Mr. Boonyuen Pakornpop (Thailand) | Hong Kong Observatory | Q1 2024 |
| Deep Learning Model of Tropical Cyclone Rainfall Nowcasting Using Satellite and Radar Data | Ms Saowapak Buphu (Thailand)  Mr Michael B. Simora (Philippines) |  | Q1 2025 |

***Annex IV***

**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.

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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.

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***Annex V***

**List of Resource Persons**

| **Member** | **Specialties** | **Name** | **E-mail** | **Affiliation** |
| --- | --- | --- | --- | --- |
| ***(A) Data Assimilation*** | | | | |
| China | TC vortex initialization | LIANG, Xudong | [Liangxd@mail.typhoon.gov.cn](mailto:Liangxd@mail.typhoon.gov.cn) | Shanghai Typhoon Institute |
| TC intensity estimation  by radar, satellite, SSMI and QuikScat | DONG, Lin  ZHOU, Bing | [donglin@cma.gov.cn](mailto:donglin@cma.gov.cn) [bingz@cma.gov.cn](mailto:bingz@cma.gov.cn) | National Meteorological Center |
| Radar data quality control and assimilation scheme | GONG, Jiandong | [gongjd@cma.gov.cn](mailto:gongjd@cma.gov.cn) | National Meteorological Center |
| Hong Kong, China | TC data assimilation, ensemble radar assimilation | K. K. HON | [kkhon@hko.gov.hk](mailto: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](mailto:ishibasi@mri-jma.go.jp) | Meteorological Research Institute |

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| --- | --- | --- | --- | --- |
| ***(A) Data Assimilation (cont’d)*** | | | | |
| Republic of  Korea | Typhoon bogussing | HA, Ji-Hyun | [jhha80@korea.kr](mailto:jhha80@korea.kr) | Korea Meteorological Administration |
| Satellite data analysis | CHUN, Hyoung-Wook | [chunhw@korea.kr](mailto:chunhw@korea.kr) | Korea Meteorological Administration |
| Radar data analysis | HA, Jong-Chul | [bellfe@korea.kr](mailto:bellfe@korea.kr) | Korea Meteorological Administration |
| USA (western North Pacific) | TC analysis, satellite interpretation, use of microwave imagery and scatterometer data | Tom LEE  Peter BLACK  Paul CHANG | [Lee@nrlmry.navy.mil](mailto:Lee@nrlmry.navy.mil)  [Peter.Black.ctr@nrlmry.navy.mil](mailto:Peter.Black.ctr@nrlmry.navy.mil)  [Paul.S.Chang@noaa.gov](mailto:Paul.S.Chang@noaa.gov) | NRL, Monterey, CA  NRL, Monterey CA  NOAA/NESDIS, Suitland MD |
| Viet Nam | TC vortex initialization; Typhoon bogussing | NGUYEN, Van Hiep | [hiepwork@gmail.com](mailto:hiepwork@gmail.com) | Viet Nam Meteorological and Hydrological Administration |
| ***(B) Modelling*** | | | | |
| China | Numerical schemes  of TC model | DUAN, Yihong | [duanyh@mail.typhoon.gov.cn](mailto:duanyh@mail.typhoon.gov.cn) | Shanghai Typhoon Institute |
| TC model physics and bogussing schemes | MA, Suhong | [mash@cma.gov.cn](mailto:mash@cma.gov.cn) | National Meteorological Center |
| Ensemble track forecasting | ZHOU, Xiaqiong | [zhouxq@mail.typhoon.gov.cn](mailto:zhouxq@mail.typhoon.gov.cn) | Shanghai Typhoon Institute |
| Typhoon modelling | LIANG, Xudong | [Liangxd@mail.typhoon.gov.cn](mailto:Liangxd@mail.typhoon.gov.cn) | Shanghai Typhoon Institute |
| Hong Kong, China | Mesoscale and ensemble TC modelling | W.K. WONG | wkwong[@hko.gov.hk](mailto:kkhon@hko.gov.hk) | Hong Kong Observatory |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***(B) Modelling (cont’d)*** | | | | | | | |
| Japan | | Ensemble track  forecasting | | KAWABATA Yasuhiro | | [kawabata@mri-jma.go.jp](mailto: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](mailto:awada@mri-jma.go.jp) | Meteorological Research Institute |
| TC modeling | | TSUJINO Satoki | | [satoki@mri-jma.go.jp](mailto:satoki@mri-jma.go.jp) | Meteorological Research Institute |
| Storm surge / wave modelling | | KOHNO Nadao | | [nkohno@mri-jma.go.jp](mailto:nkohno@mri-jma.go.jp) | Meteorological Research Institute |
| Republic of  Korea | | Global NWP model | | CHOI, Hyun-Joo | | [hjchoi81@korea.kr](mailto:hjchoi81@korea.kr) | Korea Meteorological Administration |
| Ensemble track  forecasting | | SHIN, Hyun Cheol | | [sinhyo@korea.kr](mailto:sinhyo@korea.kr) | Korea Meteorological Administration |
| Storm surge / wave modelling | | CHANG, Pil-Hun | | phchang@korea.kr | Korea Meteorological Administration |
| Thailand | | Numerical ocean wave modelling | | KANBUA, Wattana | | wattkan@gmail.com | Thai Meteorological Department |
| USA (western North Pacific) | | TC Modeling  Extratropical Transition  TC Genesis  Sub-Tropical Systems Structure | | Jim DOYLE  Pat HARR  Jenni EVANS | | [James.Doyle@nrlmry.navy.mil](mailto:James.Doyle@nrlmry.navy.mil)  [paharr@nps.edu](mailto:paharr@nps.edu)  [evans@meteo.psu.edu](mailto:evans@meteo.psu.edu) | NRL, Monterey CA  Naval Postgraduate School, Monterey CA  Pennsylvania State Univ |
| ***(C) Forecasting*** | | | | | | | |
| China | | Track and intensity  forecasting | | QIAN, Qifeng | | qianqf@cma.gov.cn | National Meteorological Center |
| Long-range prediction  of typhoon | | XU, Ming | | [Xum@mail.typhoon.gov.cn](mailto: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](mailto:wkwong@hko.gov.hk) | Hong Kong Observatory |
| TC intensity, structure and landfall impact | | C.W.CHOY | | cwchoy@hko.gov.hk | Hong Kong Observatory |
| Long-range forecasting  of TCs | | W.P.TSE | | wptse@hko.gov.hk | Hong Kong Observatory |
| TC motion, intensity,  size, modelling and seasonal prediction | | Johnny C.L. CHAN | | [Johnny.Chan@cityu.edu.hk](mailto: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](mailto:oyama@met.kishou.go.jp) | Japan Meteorological Agency |
| Doppler radar data analysis | | SHIMADA Udai | | [ushimada@mri-jma.go.jp](mailto:ushimada@mri-jma.go.jp) | Meteorological Research Institute |
| Republic of Korea | | Track and intensity forecasting | | LEE, Kyung-Ho | | [khlove1119@korea.kr](mailto: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](mailto:CHOW_Kwok_Wah@nea.gov.sg) | Meteorological Service Singapore  National Environment Agency |
| ***(C) Forecasting (cont’d)*** | | | | | | | |
| USA (western North Pacific)  USA (western North Pacific) | TC analysis and forecasting, seasonal prediction,  use of microwave imagery  and scatterometer data, Dvorak technique | | Roger EDSON | | [Roger.Edson@noaa.gov](mailto:Roger.Edson@noaa.gov) | | University of Guam (WERI)  National Weather Service, Forecast Office Guam |
| Satellite data analysis,  use of microwave imagery | | Jorel TORRES  Dan LINDSEY | | [Jorel.Torres@colostate.edu](mailto:Jorel.Torres@colostate.edu)  [Dan.Lindsey@colostate.edu](mailto:Dan.Lindsey@colostate.edu) | | NOAA/NESDIS at CIRA,  Colorado State University |
| Satellite data analysis,  use of microwave imagery, automated Dvorak Technique, AMSU | | Chris VELDEN  Derrick HERNDON | | [chris.velden@ssec.wisc.edu](mailto:chris.velden@ssec.wisc.edu)  [dherndon@ssec.wisc.edu](mailto:dherndon@ssec.wisc.edu) | | CIMSS,  University of Wisconsin-Madison |
| Satellite data analysis,  use of microwave imagery, AMSU | | John KNAFF | | [john.knaff@noaa.gov](mailto:john.knaff@noaa.gov) | | NOAA/NESDIS at CIRA,  Colorado State University |
| Satellite-based rainfall estimates in TCs (eTRaP) | | Bob KULIGOWSKI Shelden KUSSELSON | | [bob.kuligowski@noaa.gov](mailto:bob.kuligowski@noaa.gov) [sheldon.kusselson@noaa.gov](mailto:sheldon.kusselson@noaa.gov) | | NOAA/NESDIS  Suitland, Maryland |
| Viet Nam | Track and intensity forecasting; Typhoon-terrain interaction and application in forecasting; TC related heavy rainfall and strong wind forecast. | | NGUYEN, Van Hiep | | [hiepwork@gmail.com](mailto:hiepwork@gmail.com) | | Viet Nam Meteorological and Hydrological Administration |
| ***(D) Application*** | | | | | | | |
| Hong Kong, China | TC warning systems  and operations | | S.M.TSE | | smtse@hko.gov.hk | | Hong Kong Observatory |
| TC information visualization and display systems | | C.K. HO | | ckho@hko.gov.hk | | Hong Kong Observatory |
| USA (western North Pacific) | TC warning and disaster preparedness, seasonal prediction, Dvorak technique | | Chip GUARD | | [chip.guard@noaa.gov](mailto:chip.guard@noaa.gov) | | NOAA National Weather Service  Guam |

***Annex VI***

|  |  |  |  |  |  |  |  |  |  |  |  |
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| **Review of Training and Research Coordination Group (TRCG) Annual Operating Plan 2024 (including Q1 of 2025)** | | | | | | | | | | | |
| **Objective Number** | **KRAs** | **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 of 2024*  *(15-26 Jan 2024)* | RSMC Tokyo, WMO | Assessment as given in RSMC Tokyo report. | USD 11,000\* | TCTF  and Member self-funded | Yes |
| 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. | Jan-March, 2024 | HKO | Publication of research findings and development output in TCRR or other journals. | Fellowship offered by voluntary hosts. | Yes | Yes, onsite (HKO) |
| 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  Theme: Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2024  *(17-19 December, 2024)* | TMD | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 16,000 | TCTF | Yes |
| 4 | KRA 1-3 | To: conduct of international scientific workshop to raise the knowledge level of TC forecasters the ESCAP/WMO Typhoon Committee. | Invite international top scientists to participate  in the 1st AP-TCRC  International Workshop | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2024  (*19 November 2024)* | TRCG & AP-TCRC | Assessment as given in TRCG & AP-TCRC report | Self-funded | AP-TCRC | Yes |
| 5 | KRA 1-3 | To: implement training initiatives  Regular invitation of TC prevention and mitigation personnel to conduct technical training for members of the ESCAP/WMO Typhoon Committee. | Fellowship or  Attachment of researchers from TC Members to AP-TCRC,  Shanghai | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2024 *(December 2024)* | TRCG & AP-TCRC | Assessment as given in TRCG & AP-TCRC report | Self-funded | AP-TCRC | Yes |
| 6 | 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. | *25 November -5 December* 2024 | CMA | Assessment as given in CMA report. | Participation will be supported by CMA | CMA | Yes |
| 7 | 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 2025*  *(14-23 Jan 2025)* | RSMC Tokyo, WMO | Assessment as given in RSMC Tokyo report. | USD 11,000 | TCTF  and Member self-funded | Yes |

***Annex VII***

**Provisional TRCG Work Plan for 2024 – 2027 (including Q1 of 2028)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Quarter** | **Typhoon Committee Activity** | **Training and Research Activities (\*activities organized by parties other than TRCG)** | **Themes (if any) / Remarks** |
| **2024** | **Q1** | TC-56  (Malaysia) | RSMC Tokyo Attachment Training | 15 – 26 January |
| Research Fellowship | HKO Fellowship in Jan - Mar.  Theme: A study on analogue forecasting for track and intensity of tropical cyclones using deep-learning techniques |
| **Q2** |  | Research Fellowship | Fellowship or attachment visit(s) hosted by STI |
| **Q4** | 19th IWS  (China) | Roving Seminar | 17-19 December, Thailand  Theme: Artificial Intelligence for Enhanced Tropical Cyclone Prediction and Emergency Response |
| CMA Training Programme\* | 25 November – 5 December. |
| 1st AP-TCRC Forum | 19 November, China |
| AP-TCRC Fellowship or Attachment Training | December, China |
| **2025** | **Q1** | TC-57  (Philippines) | RSMC Tokyo Attachment Training\* | 14 - 23 January |
| Research Fellowship | HKO Fellowship in Feb-Apr  TRCG Research Fellowship hosted by KMA in June |
| **Q2** |  |
| **Q3** |  | Research Fellowship | Fellowship or attachment visit(s) hosted by STI |
| **Q4** | 20th IWS  (TBC) | CMA Training Programme \* | TBC |
| Roving Seminar | To be held in China. Proposed theme: Application of remote sensing technologies in operational tropical cyclone monitoring and forecasting |
| 2nd AP-TCRC Forum | TBD |
| AP-TCRC Fellowship or Attachment Training | TBD |
| **2026** | **Q1** | TC-58  (TBC) | RSMC Tokyo Attachment Training\* | TBC |
| Research Fellowship | HKO Fellowship in Jan – Mar (TBC) |
| **Q2** |  | Research Fellowship | Fellowship or attachment visit(s) hosted by KMA, STI and/or AP-TCRC. |
| **Q3** |
| **Q4** | 21st IWS  (TBC) | Roving Seminar | Hosted by: a member of Sub-group 2.Proposed theme: TBD (will be discussed in a TRCG meeting 2025) |
| CMA Training Programme\* | TBC |
| **2027** | **Q1** | TC-59  (TBC) | RSMC Tokyo Attachment Training\* | TBC |
| Research Fellowship | HKO Fellowship in Jan – Mar (TBC) |
| **Q2** |  | Research Fellowship | Fellowship or attachment visit(s) hosted by KMA, STI and/or AP-TCRC |
| **Q3** |  |
| **Q4** | 22nd IWS  (TBC) | 5th TRCG Forum / TRCG Planning Meeting  (in conjunction with 22nd IWS) | Proposed theme: TBC |
| CMA Training Programme\* | TBC |
| **2028** | **Q1** | TC-60  (TBC) | RSMC Tokyo Attachment Training\* | TBC |
| Research Fellowship | HKO Fellowship in Jan – Mar (TBC) |

***Annex VIII***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Training and Research Coordination Group (TRCG) Annual Operating Plan 2025 (including Q1 of 2026)** | | | | | | | | | | |
| **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 of 2025*  *(14-23 Jan 2025)* | 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 | HKO, KMA | 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  Proposed theme: Application of remote sensing technologies in operational tropical cyclone monitoring and forecasting | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2025 | CMA | Feedback from evaluation forms to be completed by a target audience of about 30 people. | USD 16,000 | TCTF |
| 4 | KRA 1-3 | To: conduct of international scientific workshop to raise the knowledge level of TC forecasters the ESCAP/WMO Typhoon Committee. | AP-TCRC 2ND FORUM | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2025 | TRCG & AP-TCRC | Assessment as given in TRCG & AP-TCRC report | TBD | AP-TCRC |
| 5 | KRA 1-3 | To: implement training initiatives  Regular invitation of TC prevention and mitigation personnel to conduct technical training for members of the ESCAP/WMO Typhoon Committee. | Fellowship or  Attachment of researchers from TC Members to AP-TCRC,  Shanghai | WGM, WGH and WGDRR | Provision of administrative and logistic support. | Q4 2025 | TRCG & AP-TCRC | Assessment as given in TRCG & AP-TCRC report | TBD | AP-TCRC |
| 6 | 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 2025 | CMA | Assessment as given in CMA report. | Participation will be supported by CMA | CMA |
| 7 | 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 2026* | RSMC Tokyo, WMO | Assessment as given in RSMC Tokyo report. | USD 11,000 | TCTF  and Member self-funded |