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Report on Activities of Working Group on Hydrology (WGH) of TC in 2018

(Item 9 of Tentative Program for TC 51st Session)

(Submitted by WGH)

ACTION REQUIRED:

This Committee is invited to:

a) Review the activities of TC WGH conducted in 2018
b) Approve the recommendations and AOPs of WGH for 2019 and beyond

APPENDIXES:

I. DRAFT TEXT FOR INCLUSION AT SESSION REPORT

II. Report on activities of Working Group on Hydrology (WGH) of TC in 2018

APPENDIX I

DRAFT TEXT FOR INCLUSION AT SESSION REPORT

9.2 Hydrological Component

1. The Committee reviewed the activities of the Members related to the implementation of the TC Strategic Plan and its annual operating plan (AOP) for the hydrological component during the past year. Details can be found in the **Appendix ??.**

2. The Session noted that, the water-related disaster events, including river flood, urban flood, flash flood and debris flow, and drought caused serious damage in some Members of the Committee in the past year, such as China, Laos, Japan, Republic of Korea, Malaysia, Philippines, Vietnam, etc. The hydrological departments in the Members provided valuable service of flood forecasting and warning to the decision-making departments of the Governments. The Members achieved remarkable progresses on capacity building of hydrological monitoring, data collection and flood forecasting and warning in 2018, particularly flood forecasting and warning system development in Malaysia and Philippines, Flash Flood Guidance (FFG) application in Vietnam, hydrological monitoring network construction in Laos.

3. The Session noted with pleasure that, the WGH 7th working meeting was successfully held from 9 to 11 October 2018 in Tokyo, Japan with theme of "Data Sharing for Flash Flood Risk Information". About 30 participants from 9 Members namely China, Japan, Laos, Malaysia, Philippines, the Republic of Korea, Thailand, USA and Vietnam, and the hydrologist of TCS took part in the meeting. The Session expressed its appreciation to Japan Government through the Ministry of Land, Infrastructure Transport and Tourism (MLIT) with cooperation of International Center for Water Hazard and Risk Management (ICHARM) and Infrastructure Development Institute (DID) for generously hosting the meeting. The Session also expressed its appreciation to China-side for funding one-day seminar on Decision Supporting to SOP for Costal Multi-hazards Early Warning and Reduction in conjunction with WGH 7th working meeting on 12 October 2018.

4. The Session was informed with appreciation that the Republic of Korea (ROK) is willingness to host WGH 8th Working Meeting in early October 2019.

5. The Committee was informed on the implementation status in 2018 and future activities of on-going projects (AOPs):

   a) Flash Flood Risk Information for Local Resilience

   b) Application of Hydrological Data Quality Control System in TC Members

   c) Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique

   d) OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members

   e) Impact Assessment of Climate Change on Water Resource Variability in TC Members

6. The Session noted that, MLIT and ICHARM of Japan conducted a series of activities for implementation of the project on Flash Flood Risk Information for Local Resilience in 2018, including sharing the concept and coordination of Platform on Water Resilience and Disasters, as an effort led by the International Flood Initiative (IFI). The Session also was informed that Japan will conduct a field research of IFI and compile case study of flash flood measures implemented in TC member in 2019 and beyond.

7. The Session noted that, 5 target Members, namely ROK , Lao P.D.R, Malaysia, Philippines and Thailand were selected for pilot study of the project led by ROK on Application of Hydrological Data Quality Control System in TC Members in 2018. ROK has completed the analysing the status of hydrological data monitoring and management in TC Members and surveying the Hydrological Data Quality Control System in ROK. The Session also was informed that the project will be conducted field survey, the design of hydrological data quality control system and technical report drafting in 2019.

8. The Session noted that, 4 target Members, namely ROK, Lao P.D.R, Philippines and Thailand, were selected for pilot study of the project led by ROK on Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique in TC Members in 2018. ROK has completed the analysing the status of operation and flood forecasting with radar rainfall data in TC Members, and surveying the Radar Data application and operation rules in flood forecasting system in ROK. The Session also was informed that the project will be conducted field survey in selected target Members and upgrading the Extreme Flood Forecasting System (EFFS) with embedding the stochastic forecasting system.

9. The Session noted that, the project on Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members, which was led by China, made remarkable progresses and achievement in 2018, including: a) determined the pilot cities in Vietnam, Malaysia and Philippines for OSUFFIM-II; b)set system running in Dongguan city of China; c) sent 3 expert missions to Hat Yai City of Thailand, in January 2018, September 2018 and January 2019, respectively, for DEM data collection, system configuration, and software installation. d) published the technical report for OSUFFIM-I; and e) scheduled conclusion workshop for OSUFFIM-I which will be held in Aril or May 2019 in SYS University, Guangzhou, China.

10. The Session also was informed that, OSUFFIM-II will be conducted following activities in 2019: a) to continue updating OSUFFIM software; b) to maintain the operational system running in Hat Yai city of Thailand and Dongguang city of China; c)to conduct field survey for data collection and studying urbanization pattern in 2-3 selected pilot river basins in piloting Members; and d) to initialize setting up hydrological models in 3 new pilot river basins.

11. The Session was informed that, the project on Impact Assessment of Climate Change on Water Resource Variability in TC Members, which was officially launched in 2018 by China, has been stepped forward by conducting following activities: a) selecting the pilot watershed in sub-reach of the Yellow River and collecting hydro-meteorological data and general information for the selected watershed; b) analysing the hydrological features of the catchment and configuring the RCCC-WBM model; and conducting the 2-days on-jpb training for two piloting Members, namely Malaysia and Laos. The Session also was informed that, the project will conduct following activities in 2019: a) to select piloting river-basins for Malaysia and Laos; b) to send expert missions from China to Malaysia and Laos for guiding data collection and processing, and calibration of the Research Center for Climate Change (RCCC) Water Balance Model (WBM) model; and c) to put the RCCC-WBM model into operation in selected piloting river-basins.

12. The Session was informed that, Japan-side MLIT in cooperation with ICHARM purposed two new projects for WGH:

    a) Flood Risk Watch Project for Life-saving

    b) Platform on Water Resilience and Disasters under IFI (International Flood Initiative)

13. The Session was informed that, the Flood Risk Watch Project for Life-saving was proposed by MLIT of Japan for the period from 2019 to 2022 (can be extended) for sharing the technology of 3L (low cost, long life, localized) water level gauges in TC Members. The objectives of the project is to establish more effectively flood risk watching and information sharing for life saving. The Session also noted that activities for implementing the project in 2019 was proposed as: (a) field survey and meetings in partner country; (b) to hold one-day workshop at TC members; and (c) to introduce 3L water level gauge and system in TC Members

14. The Session was informed that, the Project of Platform on Water Resilience and Disasters under IFI was proposed by ICHARM of Japan for the period from 2019 to 2022 as one of TC cross-cutting projects. The objectives of the project were briefed as: (1) collecting and sharing data under the scheme of the platforms; (2) transferring knowledge and experiences; (3) enhancing the capacity and promoting the pilot projects; and (4) reducing the flood-disaster damage in the TC Members. The Session also was also informed that the JMA is willing to join and contribute to the project from WGM side. The Session noted that activities for implementing the project in 2019 was proposed as: (a) to organize the session on the platform in the Philippines; (b) demonstrate the objectives and outcomes of the platforms in the current implementing countries; and (c) conduct the preliminary study on how to establish the platforms in TC member countries.

15. The Session noted with appreciation the efforts made by Hydrological Forecasting Center (HFC) of China in cooperation with ISTRONG Technology on Big-data Based Decision support system for Water Disaster Early Warning and Prevention, including providing funding support for one-day seminar on 12 October 2018 in Tokyo, Japan in conjunction with WGH 7th working meeting, and 2-day seminar from 22 to 24 February 2019 in Fuzhou, China which involved more than 50 participants from China, Japan, Republic of Korea, Thailand and Vietnam.

16. The Session noted that, TC WGH webpage has been continue operating for sharing information among WGH members, and has been linked with TC Webpage (http://www.typhooncommittee.org/wgh-web-page/). The webpage will be updated and operated by HRFCO continuously in cooperation with KICT and TCS.

17. The Session was informed with pleasure that, based on the full discussion and communication on its 7th working meeting and TC 13th IWS, the following consensus have been reached in WGH on the issue of chairmanship:

    a) to continue staying in chair/vice-chair system.

    b) to give the chance to more Members for serving the Group and to mobilize more resource for WGH, the participants agreed to set up one more vice chairperson (3 in total) for the Group.

    c) to propose Dr. Tetsuya Ikeda from Japan serve for WGH as Chairperson; Dr. CHO Hyo Seob from RO Korea, Dr. HOU Aizhong from China, and Mr. Kenneth Kleeschulte from Guam, USA serve for WGH as vice-chairs for approval at 51st Session to be held in Guangzhou, China from 26 February to 02 March 2019.

d) to formulate an agreeable approach for future recommendation of appointment of Chairpersons and Vice Chairpersons for WGH before 53rd Session.

18. The Committee noted that, the current Chairperson of WGH Mr. Yoshio TOKUNAGA from ICHARM of Japan expressed his willingness to retire from his position after TC 51st Session. The Committee expressed its gratitude to Mr. Yoshio TOKUNAGA for his valuable contribution to WGH during his term in past 4 years since 2015.

CONCLUSIONS OF WGH

19. On the basis of the outcomes 7th WGH working meeting and the discussion of the WGH Parallel Session at 13th IWS, the following conclusions were reached:

- To strengthen the execution of Cross-cutting project in the Committee so that to enhance the cooperation among three components. The new proposed project from Japan on Platform on Water Resilience and Disasters under IFI would be a good cross-cutting project among three working groups. The expected outcome and goals could be achieved and shared in TC Members based on the existing results and experiences between MLIT and JMA of Japan via the project.
- To strengthen flash Flood and landslide forecasting and waring. The damage caused by flash Flood and landslide disasters shown a trend of increasing in Members, for example, the annual death caused by flash flood is reached around 70% of total annual death caused by flood disasters. Using advanced monitoring technology on big-data application in flash flood disaster risk forecasting and early warning could be a good solution. China, Japan and Republic of Korea may share their experiences and results among TC Members.
- To strengthen the research and technical application on water resilience and disaster risk reduction under Climate Change. To enhance and improve the capacity of integrated water resource management (IWRM) under climate change is a pivotal issue in many TC Members. How to provide a platform for exchanging and sharing the experience on IWRM should be a topic for WGH to take actions.
- To strengthen the research and technical application on inundation mapping in urban region. The urban flood disaster in TC Members is increasing year by year. The achievements of projects of Flood Hazard Mapping (FHM) and Urban Flood Risk Management (UFRM), which were conducted by WGH in past years, should be widely extended in TC Members.
- Enhancement of the close collaboration with the AWG of WMO CHy, WMO RA II Working Group on Hydrological Services in several themes of common interest provides significant benefits to the Committee. WGH should take substantial measures to step forward.

RECOMMENDATIONS OF WGH

20. On the basis of the outcomes of 7th WGH working meeting and the discussion at the Parallel Session of 13th IWS and subsequent discussion, the WGH made the following recommendations:

- To appoint Dr. Tetsuya IKEDA from Japan serve for WGH as Chairperson; Dr. CHO Hyo Seob from RO Korea, Dr. HOU Aizhong from China, and Mr. Kenneth Kleeschulte from Guam, USA serve for WGH as vice-chairpersons since 51st to 53rd Session.

- to request US$25,000 from TCTF in total for supporting WGH members participating TC 14th IWS.
- to request US$25,000 from TCTF in total for supporting overall WGH activities for 2019 calendar year.
- to approve 2 new AOP proposals: (a) Flood Risk Watch Project for Life-saving led by MLIT of Japan from 2019 to 2022; (b) Platform on Water Resilience and Disasters under IFI led by ICHARM of Japan from 2019 to 2022 as a cross-cutting project of the Committee.
- to request the Republic of Korea to host WGH 8th working meeting with funding support in early October 2019.
- to request HRFCO to continue maintaining and operating the WGH webpage for effective sharing information among WGH members with support from KICT and TCS.
- to re-appoint the focal point of WGH, Ms. Ji-Youn SUNG, HRFCO of the Republic of Korea as the liaison to WGH of WMO RA II for WGH of the Committee.
- to continue focusing on improving the ability to forecast hydrological phenomena and provide measures for the effectiveness of the improvements.

APPENDIX II

Report on Activities of Working Group on Hydrology (WGH) of TC in 2018

In 2018, Working Group on Hydrology (WGH) of Typhoon Committee (TC) conducted a series of activities very positively referring to the decision of 50th Session which was held at in Hanoi, Vietnam from 28 February to 03 March 2018. This report was drafted mainly on the base of the outcomes of 7th WGH working meeting which was held in Tokyo, Japan from 9th to 12th October, 2018, and the discussion of the parallel session of TC 13th Integrated Workshop (IWS) which was held in Chiang Mai, Thailand from 5 to 9 November 2018.

The report highlighted the main progresses and achievements on hydrological component in Members in past year; briefed the activities of WGH conducted in 2018, and summarized the status of implementation of WGH AOPs 2018. Based on the communication among Members and the discussion at TC 13th IWS, WGH proposed the implementation plan of AOPs for 2019 and beyond; and consequently requested the TCTF allocation for supporting WGH activities in the year of 2019.

I. The Major Progresses on Hydrological Component in Members in 2018

1) The WGH reviewed the hydrological activities conducted in Members in 2018 and noted the major progresses which may benefit other Members.

2) In recent years, referring to the new theories and technology, China developed an open source GIS based distributed hydrological forecast system. This system has been put into operation since 2018. Some new products, such as the surface runoff and the flood routing process, have been generated by this system, which played an important supporting role in the successful defense of typhoon-related disasters.

3) In Japan, the TEC-FORCE of the Ministry of Land, Infrastructure Transport and Tourism (MLIT) played very prompt and important role in typhoon-related disaster reduction. In addition, the MLIT and Osaka prefecture implemented the prevention countermeasures for high tide such as constructing water gates and rebuilding drainage pump stations in response to the huge typhoon.

4) In Malaysia, to date the Department of Irrigation and Drainage (DID) has 817 telemetry stations, 1223 manual flood gauges, 153 flood warning boards and 477 automatic flood warning sirens in flood prone areas. Three new flood forecasting model (NaFFWS) have been developed and was in operation during monsoonal season, which were developed using advance technology and new capabilities to simulate the flood inundation area using 2D analysis with 7-day leading time.

5) In Philippines, GAPASA has achieved a remarkable progress and update on the flood forecasting and warning centers, and the installation of hydrological monitoring equipment in the thirteen major river basins in 2018. PAGASA has already established flood forecasting and warning systems for five (5) major river basins in 2018 and up to a total number of eighteen (18) major river basins.

6) The Republic of Korea to strengthen the flood response capacity, the government planned to increase the flood forecast points of the tributaries as well as main rivers and expands the flood information service. The projects are underway to secure the lead time for the flood forecast including the flash flood and lowland flooding.

7) In Thailand, RID provide decision support for the disasters induced by both of flood and drought. The joint committee such as RID and EGAT (Electricity Generating Authority of Thailand) played very active role in dam operation with consideration of minimizing damages in downstream community and water resource utilization.

II. Review of the seventh WGH Working Meeting

8) The 7th WGH working meeting which was held in with the theme of "Data Sharing for Flash Flood Risk Information" was held in Tokyo, Japan from 9th to 12th October, 2018 at the kind invitation of MLIT, Japan.

9) The meeting was hosted by the Ministry of Land, Infrastructure Transport and Tourism (MLIT) in cooperation with Infrastructure Development Institute (IDI), and International Center for Water Hazard and Risk Management (ICHARM), Public Works Research Institute (PWRI) of Japan with the generous offer of financial support.

10) The Meeting was co-chaired by WGH chairperson Mr. Tokunaga YOSHIO, vice chairperson Dr. Hyo-Seob CHO, and the hydrologist of TCS.

11) The meeting was attended by 28 participants in total from 9 Members, namely China, Japan, Laos, Malaysia, Philippines, the Republic of Korea, Thailand, USA and Vietnam. Dr. Jinping LIU, the hydrologist of TCS took part in the meeting. Three (3) experts (Mr. Hisaki Eito, Ms. Jitsuko HASEGAWA and Ms. Yohko IGARASHId) from JMA participated in the meeting as observer.

12) Mr. Hirokazu Tsukahara, the Director General of Water and Disaster Management Bureau, MLIT) addressed welcome speech at opening ceremony. Prof. Toshio Koike (Director of ICHARM), Dr. Hirotada Matsuki (Director of International Affairs Office, Water and Disaster Management Bureau, MLIT) and Dr. Cho HyoSeob (Director, Information Center of HRFCO) delivered technical reports on the Platform on Water Resilience and Disasters, on Rebuilding Flood-Conscious Societies, and on Flash flood forecasting and Warning, respectively.

13) The meeting reviewed the implementation progresses of WGH Annual Operating Plan (AOPs) in 2018; discussed the success indicators for AOPs in 2019 and preliminary budget request for support the activities of WGH in 2019.

14) The participants reviewed and discussed the updated proposal of co-chairs system for WGH. All participants recognized that, the proposal of co-chair system might be a good change for the Group to mobilize more resource and equal opportunity to all Members, however, it is not right time to try this new system in WGH at present. The Participants got consensus on that WGH shall stay current chair/vice-chair system, and requested TCS distribute the discussion on Chairmanship and initial nomination of chairperson and vice-chairpersons of WGH to all focal points of Members for further comments with the deadline of October 20, 2018; and also agreed to synthesize all comments together and update the Summary based on all comments by simple majority for finalization at coming 13th IWS.

15) The Meeting discussed the preparation and hydrological contribution on cross-cutting project among working groups to the 13th Integrated Workshop to be held in Chiang Mai, Thailand from 5 to 9 November 2018 and to 51st Session to be held in Guangzhou, China from 26 February to 02 March 2019.

16) The Meeting shared the technology and experiences on Decision Supporting to Standard Operating Procedures (SOP) for Coastal Multi-hazards Early Warning and Reduction. The participants had full

discussion on how to enhance impact-based, risk-based and community-based storm surge, urban flood, and sediment disaster (including flash flood, landslide and mudflow) monitoring, forecasting and warning; and on how to enhance the application of internet of things (IOT), big-data, cloud compute, and mobile internet in the aspects of water-related disaster monitoring, forecasting and early warning, and better response. The participants request China to consider the possibility of proposal of new AOP on this aspect. China-side expressed its willingness to host a small seminar with funding support on Big Data utilization in water-related disaster early warning and reduction in conjunction with 51st Session to be held in Guangzhou, China in February 2019.

17) The meeting had three technical reports, namely: (a) The Platform on Water Resilience and Disasters from Prof. Toshio Koike, Director of ICHARM; (b) Rebuilding Flood-Conscious Societies from Dr. Hirotada Matsuki, Director of International Affairs Office, Water and Disaster Management Bureau, MLIT; and (c) Flash flood forecasting and Warning from Dr. Cho HyoSeob, Director, Information Center of HRFCO.

18) The participants expressed their heartfelt appreciation to Japan Government through MLIT with cooperation of ICHARM and DID for kindly hosting the meeting and for all the excellent hospitality and logistic arrangement.

19) The RO Korea expressed its willingness to host WGH 8th Working Meeting early October 2019 in conjunction with implementation of AOP2. The participants expressed their sincere appreciation to Republic of Korea for the generous offer.

III. Progresses of WGH AOPs in 2018 and Implementation Plan for 2019

20) The implementation status and the success indicators of WGH AOPs in 2018 were reviewed and discussed. The project leaders from China, Japan and Republic of Korea presented the progresses on AOPs achieved in 2018 and implementation plans for 2019. The WGH AOPs in 2018 and beyond was summarized in the table 1. The implementation status of WGH AOP 2018 is summarized in the Annex 1 and the success indicators of AOPs in 2019 are shown in Annex 2.

Table 1 the Summary of WGH AOPs in 2018 and Beyond

Item	Projects	Driver	Duration
AOP1	Flash Flood Risk Information for Local Resilience	Japan	2017~2019
AOP2	Application of Hydrological Data Quality Control System in TC Members	Korea	2018-2022
AOP3	Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	Korea	2018-2022
AOP4	OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members	China	2018~2020
AOP5	Impact Assessment of Climate Change on Water Resource Variability in TC Members	China	2018~2020

AOP1: Flash Flood Risk Information for Local Resilience

21) Following the decision of TC 50th Session, the Meeting reviewed the progresses on the Japan-led project of Flash Flood Risk Information for Local Resilience in 2018 briefed as below:

- conducted researches on flash flood related topics in TC member countries.

- shared good practices and common issues on flash flood related topics in TC member countries between the members.
- shared the concept and coordination system of the Platform on Water Resilience and Disasters, an effort led by the International Flood Initiative (IFI).

22) In 2019, following activities will be conducted:

- To Conduct a field research of IFI activities with other TC members.
- To Compile case study of Flash Flood measures implemented in TC member countries and IFI activities.

AOP2: Application of Hydrological Data Quality Control System in TC Members

23) Following the decision of TC 50th Session, the Meeting reviewed the progresses of the project led by Republic of Korea (ROK) on Application of Hydrological Data Quality Control System in TC Members in 2018:

- Analyze the status of hydrological data monitoring and management in TC members
- Selected the 5 target countries (RO Korea, Lao P.D.R, Malaysia, Philippines, Thailand)
- Survey the Hydrological Data Quality Control System in Republic of Korea
- Exchange & confirm the results of analysis in 7th WGH Meeting, 13th IWS

24) In 2019, following activities will be conducted:

- Field survey results of status analysis for hydrological data quality control management in 5 countries (ROK, Thailand, Philippines, Laos, Malaysia)
- Design report for establishment hydrological data quality control system
- Hosting WGH 8th working meeting in early October 2019
- Drafting Technical Report (draft version) for hydrological quality control system

25) The representative from DID, Malaysia expressed that, Malaysia have a plan to improve the quality of hydrological data which is more than 19% of annual data were lost due to various factors such as faulty equipment and sensors, natural disasters, human errors during data processing, and communications errors. In addition, based on feedback from data users and researchers, they found that some of the collected data especially streamflow or rating curve data not in a very good quality. Therefore, in order to overcome and mitigate these problems, use of latest and reliable technology to improve the quality of data as well as to fill in the gap shall be carried out. He also expressed that Malaysia in willing to participate in this project with objectives to learn and improve the skills and knowledge on data quality control systems. Three (3) river basins have been proposed for the pilot study which is Pahang river basin, Johor river basin and Kedah river basin.

AOP3: Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique in TC Members

26) Following the decision of TC 50th Session, the Meeting reviewed the progresses of the project led by ROK on Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique in TC Members in 2018 and the implementation plan in 2019 briefed as below:

- Analyze the status of operation and flood forecasting with radar rainfall data in TC members
- Selected the 4 target countries (RO Korea, Lao P.D.R, Philippines, Thailand)
- Survey the Radar Data application and operation rules in flood forecasting system in Republic of Korea
- Exchange & confirm the results of analysis in 7th WGH Meeting and 13th IWS.

27) In 2019, following activities will be conducted:

- Field survey results of status analysis for flood forecasting using radar rainfall data in 4 countries (ROK, Thailand, Philippines, Laos)
- Design report for upgrading LEVEL 3 (EFFS) & establishment stochastic forecasting system

AOP4: Development Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for Selected TC Members

28) Following the decision of TC 50th Session, the Meeting reviewed the progresses of the project led by China on Development Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for Selected TC Members in past years.

29) Based on the field survey to three pilot cities of Viet Nam (including Ho Chi Ming City, Hue city and Hanoi city) from 12 to 19 of November, 2017, which was joined by project scientist Prof. Yangbo Chen, TC hydrologist Dr. Jinping Liu, and Viet Nam team members, the river basin in Hue city was selected as the pilot study in Viet Nam for OSUFFIM-II at TC 50th Session which was held in Hanoi, Vietnam in February 2018.

30) From 29 January to 2 February 2018, team member from Sun Yat-sen University, Mr. Jianming QIN and Mr. Liming DONG made a field survey to Hat Yai with Thailand team member, they collected data for model set up and visited local people for model set up. After that the model for Hat Yai was set up tentatively. From September 15 to 19, 2018, the project scientist, Prof. Yangbo Chen, visited Hat Yai again jointly with Thailand team members for validating the model structure, secure radar data integration and system installation in RID headquarter. Finalization of Hat Yai flood forecasting model and Operational system in underway, and is planned to be put into trail operation before the flood season.

31) A conclusion workshop for OSUFFIM I is planned to be held during the TC session in 2019, and the technical report is under preparation, and expected to be published and distributed during this workshop.

32) In 2019, following activities will be conducted.

- to conduct expert mission to the pilot city of Thailand in January 2019 (tentative);
- to print the publication of technic report and distribute at the 51st Session;
- to maintain the operation system in Hat Yai city of Thailand and Dongguang city of China;
- to conduct field survey, data collection and study urbanization pattern in 3 new pilot river basins;
- to set up hydrological model in 3 new pilot river basins .

AOP5: Impact Assessment of Climate Change on Water Resource Variability in TC Members

33) Following the decision of TC 50th Session, the Meeting reviewed the progresses of the project on Impact Assessment of Climate Change on Water Resource Variability in TC Members jointly led by Hydrological Forecast Center (HFC) and the Research Center for Climate Change(RCCC) under the Ministry of Water Resources (MWR) of China in 2018 and the implementation plan in 2019 briefed as below:

- selected the pilot watershed of sub-reach of the Yellow River and collected hydro-meteorological data and general information for the selected watershed.
- analyzed the hydrological features of the catchment and forced the RCCC-WBM model.

34) The performance of the model is satisfied and it could be used in other watershed. The training materials for scheduled the model training course has been prepared.

35) A two-day training workshop on RCCC Water Balance Model (WBM) for the participating Members was conducted jointly by HFC and RCCC in Nanjing, China from 19 to 20 January 2019 as one of implementation activities for the project of TC Working Group for selected Members, namely Malaysia and Laos.

36) In 2019, following activities will be conducted.

- to select Case Rivers in Malaysia and Laos, and prepare the input Data of the RCCC-WBM model
- to conduct field survey and seminar in Malaysia and/or in Laos in late April 2019;
- to calibrate the model parameters of the RCCC-WBM model and to use the model for water resources simulation in selected river basin(s).

37) The representative from DID, Malaysia expressed that, Malaysia is interested to join the study especially for understanding the water resources modeling and its application for various purposes such as Water Accounting, Water Availability, Water Demand Management, Water Allocation, Water Storing, Water Resources Indices and Water Auditing. Three (3) river basins have been proposed for the pilot study which is Kedah river basin, Melaka river basin and Bernam river basin.

IV. New Proposals for 2018 and Beyond

38) Following the discussion at WGH 7th working meeting, the participants reviewed the presentations on following two proposals as AOP6 and AOP7 of WGH from Japan and agreed to report for approval at the 51st Session.

AOP6: Flood Risk Watch Project for Life-saving

39) In recent years, due to the record-breaking amount of and extensive area of rainfalls, Japan has experienced levee breaches of river levees, long-lasting inundations and unexperienced landslides. There were a number of disaster victims, escalated by delay in evacuation. For example, over 4,200 residents were rescued from the flood due to Kinu River levee breaches caused by the long-lasting torrential rain in September 2015; 21 people were drowned at a nursing house along a small valley in Tohoku region in August 2016; over 200 people failed to evacuate during wide-spread rainfall over the western Japan in July 2018. For re-understanding the fact "large-scale floods can exceed limited river capacity" and declaring a slogan "no evacuee left behind", the MLIT of Japan established a new policy vision "Rebuilding Flood-Conscious Society". Among considerable structural/non-structural measures, the MLIT took real-time data-based approach for flood forecasting and early warning, and highlighted importance of the controlled flood discharge by using dam in the upstream. To achieve the expectation, the MLIT is promoting the 3L water level gauges to double observation stations all around Japan. Here, the 3L means low-cost, long-life and localized. In parallel to the domestic policy, the MLIT would share this new approach with TC Members to install the basic and practical effort to develop more accurate flood forecasting and activate more effective evacuation. Targeting building resilient communities in the Asia-Pacific region, Japan would assist to develop water level observation network in selected river basins of collaborative countries.

40) On this connection, MLIT of Japan is willing to propose a new AOP in TC WGH for a period of 4 years from 2019 to 2022 (can be extended) with objectives of:

- Data accuracy: people can get estimated flood peak time and water level based on the observation data.
- Local customized: including (a) an observation equipment--3L water level gauge, which can be made according to local situation; (b) the real-time and on-site data usable for people and local government; and (c) the local authority, which make the 3L water level gauges managed and repaired by themselves.
- Data supply: Central government can get local information; satellite and rain radar systems can be improved by the ground data.

41) The road map for whole implementation period was summarized as below:

- 2019: Meeting, Filed survey, Workshop
- 2020: Work shop on how to install the system
- 2021: Work shop on how to install and improve the system
- 2022: Work shop on how to install and improve the system

42) The following activities for implementation of the project will be implemented in 2019:

- field survey and meetings in partner country
- to hold one-day workshop at TC members
- to introduce 3L water level gauge and system in TC Members

AOP7: Platform on Water Resilience and Disasters under IFI (International Flood Initiative)

43) International Flood Initiative (IFI) is a worldwide framework to promote collaboration in flood management among international organizations: UNESCO, WMO and UNISDR. ICHARM has been serving as secretariat. Under IFI's scheme, ICHARM supports the establishment of the "Platform on Water Resilience and Disasters" in each country. In March 2018, High-Level Panel on Water (HLPW) stressed the formulation of the Platforms in its outcome document.

44) To demonstrate the effectiveness of establishing the platforms on water resilience and disasters by involving the national government organizations for further improved flood management in considering the widespread and devastating water-related disasters in the TC member countries, ICHARM of Japan proposed the project of Platform on Water Resilience and Disaster under IFI for the period from 2019 to 2022 as one of cross-cutting projects.

45) The project will be implemented in cooperation with JMA through WGM's Preliminary Project (PP). The objectives of the project were summarized as:

- Collecting and sharing data under the scheme of the platforms
- Transferring knowledge and experiences
- Enhancing the capacity and promoting the pilot projects
- Reducing the damage due to the flood disasters in the TC member countries.

46) The road map of the project is described as:

- 2019: Organize the session on the platform in the Philippines
- 2019-2020: Conduct the preliminary study on how to establish the platforms in the TC member countries
- 2020-2021: Organize the workshops for its demonstration and dissemination
- 2020-2021: Hold the capacity development programs
- 2022: Seek the possibility to develop the platforms in the TC member countries

47) The implementation plan for 2019 was proposed as below:

- Organize the session on the platform in the Philippines
- Demonstrate the objective and outcomes of the platforms in the current implementing countries in the WGH
- Conduct the preliminary study on how to establish the platforms in the TC member countries.

48) The Participants reviewed the proposal from HFC of China in cooperation with ISTRONG Technology on Big-data Based Decision support system for Water Disaster Early Warning and Prevention. Participants expressed their appreciation to ISTRONG Technology for willingness to involve in WGH activity with funding support. Considering the objective of proposed Project is mostly related to typhoon track displaying and forecasting, which is overlapped with WGM activity. Therefore, WGH suggested ISTRONG Technology of China to consider the possibility to revise the proposal to focus on big-data utilization on water-related disaster EW and reduction, and to confirm it before January 20, 2019. WGH welcome ISTRONG Technology of China to continue supporting WGH activities in future.

49) A Two-day seminar on Big-data Application on Water-related Disaster Early Warning and Prevention was organized in Fuzhou, China from 22 to 24 February 2019 by HFC of China in cooperation with ISTRONG Technology with funding support. The participants from Japan, Republic of Korea, Thailand and Vietnam were invited for participating in the Seminar.

50) The WGH AOPs for 2019 and beyond were summarized in Table 2.

Table 2 The summary of WGH AOPs in 2019 and beyond

Item	Projects	Driver	Duration
AOP1	Flash Flood Risk Information for Local Resilience	Japan	2017~2019
AOP2	Application of Hydrological Data Quality Control System in TC Members	Korea	2018-2022
AOP3	Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	Korea	2018-2022
AOP4	OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members	China	2018~2020
AOP5	Impact Assessment of Climate Change on Water Resource Variability in TC Members	China	2018~2020
AOP6	Flood Risk Watch Project for Life-saving	Japan	2019~2022
AOP7	Platform on Water Resilience and Disasters under IFI	Japan	2019~2022

V. Review TCTF allocation for WGH activities in 2018 and Proposed Request for 2019

51) WGH reviewed the usage of the allocated budget of TCTF for WGH activities in 2018 shown in table 3.

Table 3 The summary of TCTF Budget Request for 2018 Activities

Item	Projects	Driver	Budget
1	Support to attend Integrated Workshop (IWS) and other activities	WGH	10,000
2	Support AOP1: Flash Flood Risk Information for Local Resilience including hosting 7th WGH working meeting in Japan	Japan	5000
3	Support AOP4: OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members	China	6000
4	Support AOP5: Impact Assessment of Climate Change on Water Resource Availability in TC Members	China	4000
	Total		25,000
	Special Request for OSUFFIM Technical Report Publication	China	3000

52) Based on the discussion, WGH proposed the budget request including $10,000USD for support participation of 14th IWS to be held in Guam, USA, and $25000USD for support its activities in 2019 shown in table 4.

Table 4 The summary of TCTF Budget Request for 2019 Activities

Item	Projects	Driver	Budget
1	**AOP1:** Flash Flood Risk Information for Local Resilience	Japan	5000
2	**AOP2:** Application of Hydrological Data Quality Control System in TC Members	Korea	6000

3	**AOP3:** Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	Korea	4000
4	**AOP4:** OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members	China	6000
5	**AOP5:** Impact Assessment of Climate Change on Water Resource Variability in TC Members	China	4000
	Total		25000

VI. Chairmanship of WGH

53) Following the decision of TC 50th Session (stated in paragraph 145: The Committee reaffirmed that there are no changes to the current Chairperson and Vice-Chairperson structure of each WG as approved at the 49th Session. If the WG would like to exercise the option of using the Co-Chairperson system, the WG should submit its proposal with detail operation structure and mechanisms for discussion and approval at the future Session. The Committee recognizes that current Chair and Vice-Chair system is working well for many of the WGs, and requested AWG to further discuss with the WGs in clarifying the remaining issues), the WGH 7th working meeting coordinated and discussed the issue of WGH Chairmanship.

54) Following the discussion and decision at 7th WGH working meeting, TCS distributed the result of discussion on Chairmanship and initial nomination of chairperson and vice-chairpersons of WGH to all focal points of Members for further comments with the deadline of October 20, 2018; and synthesized all comments together and updated the Summary based on all feedback.

55) The participants reviewed and discussed (a) the Summary of Feedback on WGH Chairmanship from Members, and (b) Final Summary of WGH Chairmanship.

56) Based on the full discussion and communication, the participants got following consensus on the issue of chairmanship for WGH:

- WGH will maintain chair/vice-chair system.
- To give the chance to more Members and to mobilize more resource for WGH, the participants agreed to set up one more vice chairperson (3 in total) for WGH.
- WGH will propose Dr. Tetsuya Ikeda from Japan serve for WGH as Chairperson; Dr. CHO Hyo Seob from RO Korea, Dr. HOU Aizhong from China, and Mr. Kenneth Kleeschulte from Guam, USA serve for WGH as vice-chairs for approval at 51st Session to be held in Guangzhou, China from 26 February to 02 March 2019.
- Participants agreed to formulate an agreeable approach for future recommendation of appointment of Chairpersons and Vice Chairpersons for WGH before 53rd Session.

57) Japan reaffirmed its commitment to providing stronger support and contribution to WGH activities in future.

VII. Conclusions

58) On the basis of the outcomes at 7th WGH working meeting and further discussion at parallel session, participants recognized the importance in following aspects for further direction of WGH:

- To strengthen the importance of Cross-cutting project in TC so that to enhance the cooperation among three components. The new proposed project from Japan on Platform on Water Resilience and Disasters under IFI would be a good cross-cutting project among three working groups. The expected outcome and achievement could be shared in TC Members based on the existing results and experiences between MLIT and JMA of Japan on the project.
- To strengthen flash Flood and landslide forecasting and waring. The damage caused by flash Flood and landslide disasters shown a trend of increasing in Members. Using advanced monitoring

technology on big-data application in flash flood disaster risk forecasting and early warning is a modern solution.

- To strengthen the research and technical application on water resilience and disaster risk reduction under Climate Change. To enhance and improve the capacity of integrated water resource management (IWRM) under climate change is a pivotal issue in many TC Members. How to provide a platform for exchanging and sharing the experience on IWRM should be a topic for WGH to take actions.
- To strengthen the research and technical application on inundation mapping in urban region. The urban flood disaster in TC Members is increasing year by year. The achievements of projects of Flood Hazard Mapping (FHM) and Urban Flood Risk Management (UFRM), which were conducted by WGH in past years, should be widely extended in TC Members.

VIII. Recommendations to the Committee

59) On the basis of the deep discussion and communication, participants agreed to submit the following recommendations to the Committee at TC 51st Annual Session to be held in Guangzhou, China from 26 February to 02 March 2019:

- To appoint Dr. Tetsuya IKEDA from Japan serve for WGH as Chairperson; Dr. CHO Hyo Seob from RO Korea, Dr. HOU Aizhong from China, and Mr. Kenneth Kleeschulte from Guam, USA serve for WGH as vice-chairpersons for approval at 51st Session to be held in Guangzhou, China from 26 February to 02 March 2019.
- to request **US$25,000** from TCTF in total for supporting WGH members participating TC 14th IWS.
- to request **US$25,000** from TCTF in total for supporting overall WGH activities for 2019 calendar year.
- To approve 2 new AOP proposals: (a) Flood Risk Watch Project for Life-saving led by Japan from 2019 to 2022; (b) Platform on Water Resilience and Disasters under the IFI led by Japan from 2019 to 2022 as a cross-cutting project of the Committee**.**
- To request the Republic of Korea to host WGH 8th working meeting with funding support in early October 2019.
- to request HRFCO to continue maintaining and operating the WGH webpage for effective sharing information among WGH members with support from KICT and TCS.
- to re-appoint the focal point of WGH, Ms. Ji-Youn SUNG, HRFCO of the Republic of Korea as the liaison to WGH of WMO RA II for WGH of the Committee.
- to continue focusing on improving the ability to forecast hydrological phenomena and provide measures for the effectiveness of the improvements.

Annex 1. Implementation Status of WGH AOP 2018

Annex 2. Successor Indicators of WGH AOP 2019

Annex 1. Implementation Status of WGH AOP 2018

KRA	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources	Status Yes/No
KRA 2 KRA 3 KRA 4	1	Flash Flood Risk Information for Local Resilience	To develop a guidance tool for enhancing local resilience to flash flood disaster risks and disseminate it among the WGH member countries.	WGDRR (TBD)	Coordination	(a) First (b) Second (c) Third (d) Fourth	PAGASA of Philippines	(a.b) To prepare an interim report on actual disaster experiences and cases of good practice in English (b.c.d) To introduce IFI platform and survey potential site in WGH Member (c.d) To hold one-day workshop in conjunction with WGH 7th working meeting in Japan and make its report	5,000USD	ICHARM, MLIT	YES On-going Yes
KRA2 KRA3 KRA4	2	Application of Hydrological Data Quality Control System in TC Members	To analyses the status of data quality control in TC Members		See above	(a) First (b) Second (c) Third (d) Fourth	DID	(a)(b)(c) Analyze the status of hydrological data monitoring and management in TC members (d) Exchange & confirm the results of analysis (c)(d) Survey the Hydrological Data Quality Control System in Republic of Korea		ME	YES Yes Yes
KRA2 KRA3 KRA4	3	Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	To analyses the status of radar data application in flood forecasting in TC Members		See above	(a) First (b) Second (c) Third (d) Fourth		(a)(b)(c) Analyze the status of flood forecasting with radar rainfall data in TC members (d) Exchange & confirm the results of analysis (c)(d) Survey the Radar Data application in Flood Forecasting system in Republic of Korea		ME	YES YES Yes
KRA2 KRA3 KRA4	4	OSUFFIM phase-II: extension of Application of OSUFFIM	to extend the application of OSUFFIM in selected Members		See above	(a) First (b) Second (c) Third (d) Fourth	DID	(a) select 2 or 3 new pilot cities. (b)-(c) maintain the operation system in Hat Yai city of Thailand and Dong Guang city of China; field survey, data collection and study urbanization pattern in selected pilot cities; (d) conduct kick-off meeting for discussing work plan; summarize the operation in Thailand and China; Publication.	6000USD + 3000USD special request	HFC; SYS Uni. China	Yes Yes; on-going
KRA3	5	Impact Assessment of Climate Change on Water Resource Variability in TC Members	To selected pilot catchments and to prepare training materials of RCCC-WBM model		See above	(a) First (b) Second (c) Third (d) Fourth	DID	(a)-(b)to select pilot areas in China and participating Members; (b)-(c)to collect hydro-meteorological data and general information of typical catchment with the supports from target countries; (c)-(d)to analyze hydrological features of selected catchments, test performance of RCCC-WBM model; prepare training materials of RCCC-WBM model; and (d) to organize the first seminar.	4000USD	HFC; NHRI, China	On-going On-going Yes On-going

- KRA 1: Enhance capacity to monitor mortality and direct economic loss caused by typhoon-related disasters.
- KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.
- KRA 3: Improve typhoon-related flood control and integrated water resource management.
- KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

- KRA 5: Enhance Typhoon Committee's Regional and International collaboration mechanism.

Annex 2. Success Indicators of WGH AOP 2019

KRA	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources
KRA 2 KRA 3 KRA 4	1	Flash Flood Risk Information for Local Resilience	To develop a guidance tool for enhancing local resilience to flash flood disaster risks and disseminate it among the WGH member countries.	WGDRR WGM 【TBD】	Coordination	(a) First (b) Second (c) Third (d) Fourth	PAGASA of Philippines	(a-c)Conduct a field research of IFI activities with other TC members. (b-d) Compile case study of Flash Flood measures implemented in TC member countries and IFI activities.	5000USD	ICHARM, MLIT
KRA2 KRA3 KRA4	2	Application of Hydrological Data Quality Control System in TC Members	To analyses the status of data quality control in TC Members		See above	(a) First (b) Second (c) Third (d) Fourth	PAGASA; DID; Malaysia; HMD, Laos, RID, Thailand	(a)(b) 1st Field survey results of status analysis for hydrological data quality control management in 5 countries (ROK, Thailand, Philippines, Laos, Malaysia) (c)(d) Design report for establishment hydrological data quality control system (c)WGH working meeting (d) Technical report (draft version) for hydrological quality control system	6000USD	HRFCO, ME
KRA2 KRA3 KRA4	3	Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	To analyses the status of radar data application in flood forecasting in TC Members		See above	(a) First (b) Second (c) Third (d) Fourth	PAGASA; DID; Malaysia; HMD, Laos, RID, Thailand	(a)(b) 1st Field survey results of status analysis for flood forecasting using radar rainfall data in 4 countries (ROK, Thailand, Philippines, Laos) (c)(d) Design report for upgrading LEVEL 3 (EFFS) & establishment stochastic forecasting system	4000USD	HRFCO, ME
KRA2 KRA3 KRA4	4	OSUFFIM phase-II: extension of Application of OSUFFIM	to extend the application of OSUFFIM in selected Members		See above	(a) First (b) Second (c) Third (d) Fourth	RID, Thailand; DID, Malaysia MHA, Vietnam	(a) OSUFFIM workshop during TC session in 2019, publication of report (b)-(c) maintain the operation system in Hat Yai city of Thailand and Dongguang city of China; field survey, data collection and study urbanization pattern in 3 new pilot river basins, training workshop during WGH meeting in 2019 (d) hydrological model set up in 3 new pilot river basins .	6000USD (for data collection, field survey and a workshop)	HFC; SYS Uni. China

KRA	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources
KRA3	5	Impact Assessment of Climate Change on Water Resource Variability in TC Members	Application of RCCC-WBM model at selected pilot catchments		See above	(a) First (b) Second (c) Third (d) Fourth	DID, Malaysia MHD, Laos	(a) to select Case Rivers in Lao and Malaysia and prepare the input Data of the RCCC-WBM model (b) field survey and meetings at Laos and Malaysia (c)-(d) to calibrate the model parameters of the RCCC-WBM model and to use the model for water resources simulation	4000USD (for data collection, field survey and meetings)	HFC and NHRI of China
KRA1,2, 3,4,5	6	Hydro Risk Watch Project for Life-saving	Promoting to install 3L water level gauge and flood forecasting system in TC Members	WGM	See above	(a) First (b) Second (c) Third (d) Fourth		(a) field survey and meetings in partner country (b) to hold one-day workshop at TC members (c-d) to introduce 3L water level gauge and system in TC Members	0	MLIT
KRA1,2, 3,4,5	7	Platform on Water Resilience and Disasters under the International Flood Initiatives (IFI)	Demonstrating the effectiveness of establishing the platforms on water resilience and disasters by involving the national government organizations for further improved flood management through collecting data, transferring knowledge and enhancing the capacity	WGM WGDRR	See above	(a) First (b) Second (c) Third (d) Fourth	PAGASA DPWH, OCD	(a) Organize the session on the platform in the Philippines (a)-(b) Conduct the preliminary study on how to establish the platforms in the TC member countries. (b)-(c) Organize the workshops for its demonstration and dissemination (b)-(c) Hold the capacity development programs (d) Seek the possibility to develop the platforms in the TC member countries	0	MLIT

- KRA 1: Enhance capacity to monitor mortality and direct economic loss caused by typhoon-related disasters.
- KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.
- KRA 3: Improve typhoon-related flood control and integrated water resource management.
- KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.
- KRA 5: Enhance Typhoon Committee's Regional and International collaboration mechanism.