ESCAP/WMO Typhoon Committee
8th IWS/2nd TRCG Forum
"Forecasting, Warning and DRR Strategies in the Mitigation of Tropical Cyclone Impact in a Multi-hazard Environment"
2 – 6 December 2013
Macao Science Center, Macao, China

SUMMARY REPORT for WGH Parallel Sessions

Organization of WGH Session

1) Typhoon Committee (TC) Working Group on Hydrology (WGH) had its parallel sessions during TC 8th TC integrated Workshop (IWS) in conjunction with the 2nd Training and Research Coordination Group (TRCG) Forum, which was held in Macao, China from December 2 to 6, 2013, as the proposed program of 8th IWS/2nd TRCG Forum.

2) The Sessions were convened by Chairperson of WGH Mr. Minoru KAMOTO, Chief Researcher of International Centre for Water Hazard and Risk Management (ICHARM) of Japan, and co-chaired by Dr. LEE Sang Heon, Director of River Information Center HRFCO, Han River Flood Control Office, Ministry of Land, Infrastructure and Transport, Republic of Korea..

3) The Sessions were attended 29 participants totally including 24 delegates from 11 Members (China; DPR Korea; Japan; Hong Kong, China; Laos; Macao, China; Malaysia; the Philippines; RO Korea; Thailand; USA and Viet Nam), 3 invited keynote speakers and hydrologist of TCS. TC Secretary Mr. Olavo Rasquihno partially took part in WGH parallel session.

4) The WGH Sessions include:

- to review hydrological activities in Members
- to discuss the topics with WGH sub-theme of hydrological role in the mitigation of hazards caused by tropical cyclones
- to review the 2nd working meeting of WGH
- to review implementation status of WGH AOP2013
- to exchange information on priorities and key areas and to propose WGH AOPs for 2014 and beyond
- to propose budget for WGH activities in 2014
- to have scientific lectures related WGH AOPs
- to discuss the WGH draft reports with conclusions and recommendations for presentation to 46th TC Session

Activities on Hydrological Component in Members

5) The representative from China; DPR Korea; Japan; Hong Kong, China; Laos; Malaysia; the Philippines; RO Korea; Thailand; Viet Nam presented their Member Reports related to

hydrological component. The hydrological activities of Members in 2013 will be described in the Appendix of 46th Session Report.

6) The meeting noted that, severe rainstorm, storm surge, flood, landslide events were induced by tropical cyclones in Members in 2013, particularly in China, Japan, Malaysia, Philippines and Viet Nam. Hydrological Services in those Members provided effective forecasting and warning on reducing the impact of typhoon-related disasters.

7) The Meeting noted that, China has made significant efforts on the aspect of reporting hydrological information of medium and small-sized reservoirs, and flood forecasting in the typhoon-affected regions in 2013. Up to now, the National Center is able to receive the real-time hydrological information from nearly 6000 reservoirs totally in the country; and the hydrological authorities in the typhoon-affected regions issued real-time flood forecasts for more than 2100 station-times.

8) The Meeting noted that the Ministry of Water Resources of China issued the National Standard of Hydrological Early Warning Signals and the National Standard of the Measures for Publicizing Hydrological Early Warning Signals and Relevant Management in 2013 for enhance public awareness of flood risk.

9) The meeting noted that, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) immediately dispatched its Technical Emergency Control Force (TEC- FORCE) to the island to evaluate the extent of the damage and prevent secondary disasters. TEC- FORCE set up a video monitoring system to observe streams affected by debris flow and performed emergency ground surveying at all local streams and slopes considered to be at risk of further damage to clarify the possibility of secondary disasters before the approaching Typhoon Francisco (1327) arrived. The group also provided monitoring system information and the results of the emergency ground surveying to the local prefectural government and municipal office in order to support decisions relating to resident safety.

10) The meeting noted that, dynamic hydrological and hydraulic computer models for the drainage systems managed by Drainage Services Department (DSD) of Hong Kong, China were developed to provide information on the risk of flooding, impacts of development and the performance of various flood protection options. These models would be updated under various ongoing and planned Drainage Master Plan (DMP) Review Studies. To cope with the latest development in the community and also the effects of changing weather patterns, DSD has commenced the review studies for DMPs of different regions in phases.

11) The meeting was informed that, in order to reinforce the capability of urban flooding monitoring, Meteorological and Geophysical Bureau (SMG) of Macao, China is cooperating with Land, Public Works and Transport Bureau and Civic and Municipal Affairs Bureau to construct 8 brand new water level monitoring stations (WLMS), which are distributed in Macao peninsula, Taipa and Coloane, respectively. The new WLMS will come into operation in the beginning of 2014.

12) The meeting noted that several flood forecasting models have been developed to support flood forecasting tasks in the Department of Irrigation and Drainage (DID), Malaysia, namely: (1) Integrated Flood Forecasting and River Monitoring System (IFFRM) for Klang Valley; (2) Atmospheric Model Based Rainfall & flood Forecasting System (AMRFF) for Pahang, Kelantan and Johor rivers; (3) Integrated Flood Forecasting and Warning System for Muda river basin; (4) Integrated Atmospheric and Radar-Satellite Model-Based Rainfall and Flood Forecasting for Sarawak river basin; (5) Integrated Flood Forecasting and Warning System Based on Real Time Radar Rainfall for Padas river basin; and (6) Integrated Flood Forecasting and Warning (IFFW) System for Dungun river basin. The meeting also noted the flood warning siren system using in Malaysia.

13) The meeting noted the severe disaster caused by strong wind of Typhoon Haiyan in Philippines and the activities conducted by PAGASA on forecasting and warning to Haiyan. The meeting also noted Philippines established the Flash Flood Alert System (FFAS) which

will alert downstream communities in Cagayan de Oro City for impending flash flood resulting from intense rainfall (threshold) derived from the QPE of radar data and automatic weather stations.

14) The meeting noted that, Republic of Korea perfected the Integrated Real-time Discharge Measurement System and developed a waterfront zone flood information provision system based on GIS and Smartphone in 2013 which has been applied in some areas of the Han river basin, and will be expanded to other major basins until 2017.

15) The Meeting was informed with appreciation that, HFRCO in cooperation with KICT initiated Webpage for TC WGH (http://tcwgh.hrfco.go.kr). This webpage is focusing on the technical issues with the purposes.

The Second Working Meeting of WGH

16) The WGH parallel session reviewed the second WGH working meeting with the theme of "Extreme Flood and Flood Forecasting System in TC", which was held in Seoul, Korea from 14 to 17 October 2013 at the kind invitation of the Ministry of Land, Infrastructure and Transport (MOLIT), Republic of Korea with generous offering of financial support.

17) The objectives of the WGH second working meeting were:

- to review the implementation progresses of WGH Annual Operating Plan (AOP);
- to review the floods happened in China, the Philippines and Thailand;
- to discuss the activity plan for WGH in 2014; and
- to discuss the preparation of the 8th IWS/2nd TRCG Forum

18) The meeting was hosted by Han River Flood Control Center (HRFCO) of MOLIT in cooperation with Korea Institute of Construction (KICT) and co-chaired by WGH chairperson Mr. Kamoto Minoru and Vice Chairperson Dr. Sang Heon LEE. The Director General of HRFCO Dr. Mr. Hajoon Park delivered his opening address and attended the meeting of 2nd day morning. Totally about 22 participants from Japan, Korea, Laos, Malaysia, Philippines, Thailand, Vietnam and TCS took part in the meeting.

19) The meeting was informed that the third WGH working meeting will be held in October 2014 with funding support from Republic of Korea. The participants of WGH recognized that the working meeting is a very important event for WGH to review the progresses of the AOPs and to prepare the IWS. WGH expressed its highest appreciation to Korea Government through HRFCO of MOLIT for supporting and organizing WGH annual working meeting.

Participating in IWS of PTC

20) The meeting was informed that, Dr. LEE SangHeon was invited to participate in the IWS of Panel of Tropical Cyclone which was held in Bangkok, Thailand from 27 to 30 November 2013.

21) The meeting was reported the summary of IWS of PTC by Dr. LEE Sangheon and noted the opportunity of cooperation on hydrological activities between TC and PTC.

Progresses WGH AOP in 2013 and Plan for 2014

22) There are 8 projects related to WGH in 2013 listed in table 1. The implementation status is shown in Annex 1 and the success indicators for 2014 are shown in Annex 2.

Table 1 Summary of WGH AOPs in 2013

	Projects	Diver	Duration
AOP1	Assessment System of Flood Control Measures on Socio-economic Impacts	Korea	2008-2014
AOP2	Extreme flood forecasting system	Korea	2012~2016
AOP3	Estimation for Socio-economic Impact of Sediment-related Disaster	Japan	2013~2015
AOP4	Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for Selected Pilot City	Macao, China /TCS	2013~2016
AOP5	Extension of Xin'anjiang Model Application in Selected River Basins in TC Members	China	2013~2016
AOP6	Guidelines for extreme flood risk management in TC region	Korea	2013-2015
AOP7	Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data	Japan	2013-2017
AOP8	Project of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP)	TCS	2013-2014

AOP1: Assessment System of Flood Control Measures on Socio-economic Impacts

23) The meeting noted that, HRFCO of MOLIT, in cooperation with KICT, finalized the Guideline of Structural Flood Control Measure Assessment System. The Guideline will be printed and distributed at coming 46th Annual Session.

24) The meeting noted with appreciation the progresses on ASFCM application in selected river basins in TC Members, also noted that there is still application requirement of this project from TC Members.

25) The meeting was informed that this AOP will be extended one more year to 2014. The meeting noted that, new case studies will be conducted in TC Members including Malaysia, Philippines, and Thailand. The meeting was informed that, HRFCO, in cooperation with KICT, will prepare the technical report of ASFCM including the implementation and application (case study) in TC members and publish the report in 2014.

AOP2: Extreme Flood Forecasting System

26) The meeting noted the progressed of AOP2 in 2013 including:

a) comparative analysis of the flood characteristics in TC members

b) using the results of flood vulnerability analysis in 4 selected river basins in linkage with AOP6

c) investigation of the Flood Forecasting System with on-line & 2013 field survey

d) proposal of the establishment direction for the appropriate Extreme Flood Forecasting System

27) The meeting was informed that, HRFCO of MOLIT of Korea, in cooperation with KICT and K-water successfully conducted the second field survey from 27 October to 02 November 2013 with 8 participants from Korea, Laos, Thailand. The necessary data was collected from selected river basins including Nakdong river in Korea, Chao Phraya river in Thailand,

Pamanga river in Philippine, and Nam Ngum River in Lao PDR. The meeting noted that, the survey reached the expected goals including:

a) to gather additory data set for AOP2 and AOP6 to set an optimal direction for making the guidelines for flood risk management and establishing flood forecasting system in TC region;

b) to understand unique environmental, social and economic characteristics of each member counties for appreciate flood forecasting system; and

c) to strengthen international cooperation to reduce flood damage by typhoon.

28) The meeting expressed its sincere appreciation to Korea Government through HRFCO for organizing this field survey with providing funding support, and also to the close cooperation from Philippines, Thailand and Laos PDR.

29) The meeting was informed the Plan for of AOP2 in 2014 and beyond including:

a) conducting the 3rd field survey for data collection in selected Members

b) confirmation of the establishment direction for the appropriate extreme flood forecasting system

c) computational design of the suitable extreme flood forecasting system with PC-version

30) The meeting noted the comments and suggestions from field survey to 3 Members to improve their flood forecasting system, particularly the strategic plan for integrated flood risk management and integrated river basin management.

AOP3: Project on Estimation for Socio-economic impact of Sediment-related Disaster

31) The meeting noted that, AOP3 mostly was achieved its successor indicators in 2013. Japan side fixed the procedure and the data collecting format for surveying sediment-related disasters.

32) The meeting was informed that, the implementation plan of AOP3 for 2014 is mainly as bellow:

- to survey sediment-related disasters based on the procedure and the data collecting format from TC Members;
- to establish the "Sediment-related Disaster Record Database" for sharing the records among TC Members.

33) The meeting noted that, Japan-side required TCTF 2014 budget for supporting SABO workshop in conjunction with next IWS to share Japanese SABO technology of sediment-related disaster prevention among TC Members. The meeting expressed the willingness on that, WGDRR participants should be encouraged to consider the possibility to join this workshop.

34) The meeting was informed that, Hong Kong, China has submitted its contact person for this project as requested by WGH after its 2nd Working Meeting. The Members were encouraged to nominate their contact persons for this project and were suggested that the WGH focal points will be to contact persons in the Members for this project if no new persons are nominated before TC 46th Annual Session to be held in Bangkok, Thailand from 10 to 13 February 2014.

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

35) The meeting was informed that, the grand application from the Science and Technology Development Fund (STDF) of Macao Government was terminated in 2013 for the implementation of the project on the Development of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members which was approved at TC 45th annual Session held in Hong Kong, China.

36) The participants were conscious of the importance and necessity of development of a prototype real time OSUFFIM for TC Members to promote the capacity of early warning of urban flood and emergency response, particularly urban flood forecasting and inundation mapping.

37) The meeting was aware of that, the initial work which was conducted in 2013 should be a kind of fundamental preparatory work for developing OSUFFIM in future. The meeting expressed its appreciation to Royal Irrigation Department (RID) of Thailand and Sun Yat-Sen University of China for their strong cooperation and support to the project during the preparatory.

38) The meeting was informed with sincere gratitude that, China is willing to take the role of leading country for this project with the cooperation of Sun Yat-Sen University of China starting from 2014, and promised to provide necessary expertize support and to seek the possibility of funding support to the implementing this project.

39) Also the meeting noted with appreciation that Sun Yat-Sen University is willing to contribute this activity for Typhoon Committee based on its existing achievement on urban flood inundation mapping. Prof. CHEN Yangbo, the head of the Laboratory of Water Disaster Management and Hydro-informatics (Laboratory of WDMH) of SYS University expressed that his Laboratory will use the budget of its own project on UFRM to start necessary preparatory work for development of OSUFFIM.

40) The meeting noted that the detailed implementation plan and mechanism need to be discussed among relevant stake-holders and will be submitted to the Annual Session for approval. The meeting discussed and agreed to use allocated TCTF budget for OSUFFIM in 2013 to hold a small –meeting in SYS University for the purpose of kick-off meeting

41) The meeting noted the suggestion from China-side to set up a working team for this project consisting experts from China, Japan and Korea, and focal points from Members of selected pilot cities for enhancing the implementation effectively and efficiently, and exploring the expertize support and mobilization of funding support

AOP5: Xin'anjiang Model Application in Selected River Basins in TC Members

42) The meeting was informed with pleasure that, the project on Xin'anjiang Model Application in Selected River Basins in TC Members (AOP2), led by Bureau of Hydrology (BOH) of China in cooperation with Department of Irrigation and Drainage (DID) of Malaysia, fully achieved the goals of implementation plan in 2013, including:

a) BOH, in cooperation with Hohai University of China, accomplished the improvement and perfection of the English version of application platform for Xin'anjiang Model, and provided the instruction of Model;

b) The training course was successfully conducted in Kuala Lumpur, Malaysia from October 21 to 25, 2013. China-side sent 2 resource persons from BOH and Hohai University to the course, and about 25 participants from Malaysia attended the course;

c) DID, Malaysia has commenced developing flood forecasting system by using Xin'anjiang Model for Segamat River Basin of Malaysia. The system has been used on trial in the river basin and hopefully will be used in operation in 2014.

43) The meeting was informed with appreciation that, as requested by DID of Malaysia, BOH of China will conduct one week on-job-training in Beijing or/and Kuala Lumpur on flood

forecasting model (Xin'anjiang Model) application for Malaysia and other interested Members in 2014 subject to available funding from TCTF.

44) The meeting noted with appreciation that DID Malaysia is willing to cooperate in organizing the programme if held in Malaysia.

45) The meeting also noted that, the representative from National Center for Hydro-Meteorological Forecasting (NCHMF) of Vietnam expressed the interest to join the above-mentioned on-job-training course.

AOP6: Guidelines for Extreme Flood Risk Management

46) The meeting noted the progressed of AOP6 in 2013 including:

a) Suggestion of the Extreme Flood Definition in hydrologic and socio-economic aspects

b) Discussion and confirmation of the Extreme Flood Definition

c) Comparative flood vulnerability analysis in 4 selected river basins

d) Investigation of flood features for the 4 selected Rivers with on-line & 2013 field survey to collect data including geographical characteristics (land use, river profiles, etc) and hydrological characteristics (mean annual precipitation & runoff, inundated areas, etc)

47) The meeting was informed the Plan for of AOP6 in 2014 including:

a) Additional Investigation of flood features for the 4 selected Rivers with on-line & field survey and analysis of the flood characteristics

b) Suggestion of the structural and non-structural countermeasures for extreme flood

c) Suggestion of the draft of guideline for extreme flood risk management and refining, consulting with TC members

AOP7: Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data

48) The meeting was informed the initial roadmap of AOP7 from 2013 to 2017:

a) FY 2013: Developing Prototype system (ICHARM) and Surveying of test fields
b) FY 2014: Developing Prototype system (ICHARM), Correcting ground truth data on test fields, Analyzing on test fields, and Workshop on test fields
c) FY 2015: Feasibility study of system on test fields, Workshop on test fields, and Developing System (ICHARM)
d) FY 2016: Feasibility study of system on test fields, Workshop on test fields, Developing of System (ICHARM), and Developing of Training Program
e) FY 2017: Improvement of system (ICHARM), Developing of Training Program, Workshop and Training

AOP8: Project of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP)

49) The meeting was informed the achievements/progresses of this cross cutting of the Committee up to nowadays, including:

- Implemented recommendations from SSOP project kickoff meeting and developed project guidance recommendations at pre-7th Integrated Workshop meeting on SSOP in Nanjing, China last November;

- Approval of the terms of reference of the Steering Committee, Task Force and Project Manager/(Technical Advisor) for the SSOP project;
- Selection of the Project Manager/(Technical Advisor) for SSOP project;
- Established collaboration with organizations implementing similar projects under ESCAP Trust Fund and others;
- Held SSOP workshop with 13 beneficiary countries participating and ESCAP, ADPC, ABU, RIMES, IOC-UNESCO, WMO, TC, PTC, JMA and USNWS.
- Conducted the piloting in 3 selected Countries (Philippines, Pakistan and Bangladesh) from 3 to 11 October 2013 with TC, PTC, ADPC and ABU involved.

50) The meeting also was informed the initial plan in next steps for SSOP project:

- WMO/ESCAP Panel on Tropical Cyclones Integrated Workshop from 26 to28 Nov 2013, in Bangkok, Thailand
- ESCAP/WMO Typhoon Committee Integrated Workshop from 2 to 6 Dec 2013, in Macau, China
- ESCAP/WMO Typhoon Committee Annual Session from 10 to 23 Feb 2014, in Bangkok, Thailand
- WMO/ ESCAP Panel on Tropical Cyclones Annual Session Dhaka in Bangladesh
- Training on SSOP Manual/ Handbook Tentative from 10 to11 Jun 2014
- Sub-regional workshop on SOPs for storm surges if needed

51) The meeting noted the outcome and achievement of SSOP could greatly benefit the Members, and the Members should be encouraged to contribute this project.

52) The WGH AOPs in 2014 and beyond are summarized in table 2.

Table 2 the summary of WGH AOPs in 2014 and beyond

	Projects	**Diver**	**Duration**
AOP1	Assessment System of Flood Control Measures on Socio-economic Impacts	Korea	2008-2014
AOP2	Extreme flood forecasting system	Korea	2012~2016
AOP3	Estimation for Socio-economic Impact of Sediment-related Disaster	Japan	2013~2015
AOP4	Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members	China	2014~2017
AOP5	Extension of Xin'anjiang Model Application in Selected River Basins in TC Members	China	2013~2016
AOP6	Guidelines for extreme flood risk management in TC region	Korea	2013-2015
AOP7	Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data	Japan	2013-2017
AOP8	Project of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP)	TCS	2013-2014

Other Discussion

53) The Meeting noted that the Change of PMP in the region due to climate change could impact PMF and consequently impact infrastructure construction and standard of flood control. The progresses and achievements on PMP research made by prof. Bingzhang LIN, dean, College of Hydrometeorology, Nanjing University of Information Science & Technology (NUIST) could benefit TC Members.

54) The meeting also noted the requirement from Participants to consider the possibility of conducting roving seminar and/or training course for TC Members on PMP/PMF review and study taking into consideration climate change.

55) The meeting noted with pleasure that, UFRM Guidelines was published and distributed at 8th IWS/2nd TRCG Forum. The meeting expressed its appreciation to China as leading country of TC cross-cutting project of UFRM and to all main drafters of Guidelines for their contribution.

Technical Lectures

56) Dr. Cho Wanhee, from K-water, presented Dam Operation for Extreme Flood. In his presentation, he emphasized that the heavy rainfall challenged dam operations and caused severe flooding. Flood control operations in dam, which are an important element of many multi-objective water resources systems, must ultimately create a balance between flood risk and other system objectives such as water supply or hydropower production. Water resources operating policies that attempt to preserve this balance are usually predicated on assumptions of stationary climate conditions derived from historic streamflow records. He introduced the methodology of estimation of flood control effect by dam operation and operation rules. He pointed that, the proper balance should be pay close attention between structural measures (including dam construction, levee reinforcement, and flood control capability enhancement, etc.) and non-structural measures (including early warning & emergency relief, IRWM Technology, and Emergency action plan) in response to the extreme flood. He also briefed the research procedures in 2014 and 2015.

57) Prof. CHEN Yangbo, from Laboratory of Water Disaster Management and Hydro-informatics, Sun Yat-sen (SYS) University of China, introduced the Real-time Urban Flood Forecasting and Inundation Mapping for Emergency Management in China. In his study, an urban flood forecasting model is presented which utilized the high resolution satellite image to delineate the high density buildings and runoff routing networks, and then is coupled with the fine resolution radar-based precipitation, and the Dongguan City area in Southern China is used to validate this method. The studied area, with a drainage area of around 200km2, is a downtown area within Dongguan City with high density population and commercial buildings, while the most parts of the rivers are covered with concrete roads. The urban flood forecasting model divides the whole studied area into several sub-drainage areas based on the DEM and river networks, and the sub-drainage areas are further divided into polygon cells referencing to high resolution satellite images and drainage networks. Further a routing network is delineated according to the topography and the building type and structures, which include land routing channel, continues dyke routing channel and special routing channel. The surface runoff is first produced on the cells by using rainfall-runoff model that determines the runoff according to the land cover type, the surface runoff is then routed to the land routing channel by employing two-dimensional unsteady flow model, the surface runoff routing in land routing channel, continues dyke routing channel and special routing channel are calculated by using one-dimensional flow model, the pipeline routing is also solved using the one-dimensional flow model. The research results show that the method proposed is promising, and could be used for real-time urban flood forecasting, thus being used for urban flood warning. Based on the this method, a real-time urban flood forecasting and warning system is set up for the Dongguan City flood mitigation, and has been put into operation for a few years.

58) Mr. Yoshikazu SHIMIZU, from ICHARM, Public Works Research Institute (PWRI), Japan, presented the Overview of Prediction of Sediment related Disaster by the Satellite Data. In his presentation, he introduced the methodology of setting sediment related disaster warning and evacuation critical rainfall based on assessment of the risk of a sediment-related disaster within a specified area induced by rainfall, without taking into consideration the local topography, geology, vegetation and other factors of individual locations. In the methodology, the criterion is set by combining two indices: the short-term rainfall index and long-term rainfall index. The short-term rainfall index is defined as the 60-minute total rainfall; the long-term rainfall index as the soil-water index, which is an estimation of the retention status of fallen rainfall in soil. He emphasized that the critical line should be revised as necessary based on new rainfall data and disaster data obtained after establishment. Finally he informed that a feasibility study was conducted on the Japanese prediction methodology for sediment related disasters by using satellite based rainfall data in consideration of not enough rainfall gauge stations in developing countries.

59) Dr. Cho Wanhee, from K-water, presented Dam Operation for Extreme Flood Preparation linked with AOP2 and AOP6. He introduced the experience on dam operation for extreme flood in Philippines, Thailand and Korea, as well as countermeasures of extreme flood and its data requisition

60) Dr. Mr. Chungsoo Kim, from KICT of Korea, presented the comparison of flood vulnerability in selected river basins of TC Members. He introduced three indicators for analyses of flood vulnerability, i.e.: PI (Pressure Index) reflecting hydrological characteristics and geological characteristics, SI (State Index) reflecting annual average flood damage and RI (Response Index) reflecting flood management measures and investment for flood management. The meeting was informed that this methodology will be used in the selected river basins (i.e. Nakdong river of Korea, Chao Phraya river of Thailand, Pampanga of Philippines and Nam Ngum river of Laos) in 2014.

61) The Meeting discussed the initial consideration on Extreme Flood Definition presented by Mr. CHA Jun-Ho from HRFCO of Korea. He briefed the literature review and proposed the extreme flood definition should be considered with various aspects including hydrologic definition, socio-economic definition, flood control capacity and climate change. The participants exchanged their experiences and commented that, the definition of extreme flood may be in different ways for different purposes such as operational flood control and flood design. It was suggested that, the definition of extreme flood might be appropriated to be given in a general wording with consideration of historic flood record, return period, range of river catchment and rainfall density as relative detail criterion for different situation.

Budget Proposed for WGH Activities in 2014

62) WGH proposed $34,000USD TCTF totally to support WGH activities in 2014 shown in Table 3.

Table 3 The summary of budget of TCTF to support WGH activities in 2014

1	Support to attend Integrated Workshop (IWS) and other activities	10,000
2	Support the ASFCM Application in TC members	3,000
3	Support to the data collection (3rd field survey) in selected Members for the project on Extreme Flood Forecasting System	3,000
4	Support for on-job training course of Flood Forecasting (Xin'anjiang) Model Application in Beijing or/and Kuala Lumpur for selected river basins in Malaysia and other interested TC Members	5,500
5	Support to host the workshop for the project on Guidelines for extreme flood risk management in TC region led by Korea	3,000

6	Support activities related to OSUFFIM	6,000
7	Support to be held SABO workshop to prevent sediment-related disaster prevention led by Japan in conjunction with 9th IWS.	3,500
	Total	**34,000**

Conclusions of WGH:

63) On the basis of the outcomes 2nd WGH working meeting and the discussion of the WGH Parallel Session, the following conclusions were reached:

- The working meeting of WGH is very important to review hydrological activities and implementation status of WGH AOPs and to prepare IWS and annual session. The meeting should be continued.
- To improve the capacity on hydrological phenomena forecasting is a continual challenge in developing Members. WGH needs to continue conducting activities focusing on the capacity building in aspects of flood monitoring, simulation, forecasting, and analysis covering river flood, urban flood, sediment disasters, storm surge, etc.
- UFRM Guidelines, as a final outcome of TC Cross-cutting project of UFRM, was published as TC publication which collected the expertise and experience on urban flood risk management among TC Members, and will undoubtedly benefit Members. However, Members still expect concrete measure to promote the capacity on urban flood forecasting and inundation mapping. As the subsequent activity of TC Cross-cutting project of UFRM, development and application of OSUFFIM would play very meaningful and important role for TC Members to promote the capacity on the technique of urban flood forecasting and warning. Also, technical training courses on urban flood forecasting, inundation mapping and damage assessment should be considered as subsequent activities of project of UFRM in the Committee.
- Inundation assessment under the combined risks of heavy rain, river flooding, waves and tides, and storm surge should be considered not only in coastal region but also in urban area in the Members with considering the damage assessment so that more relevant information could be provided to decision-makers of DRR.
- There is agreement on the necessity and importance to conduct PMP/PMF review and study in TC Members considering the change of rainfall pattern under climate change, which surely impacts the standard design for flood control, infrastructure construction, strategic plan, and consequently impact the effectiveness and efficiency of DRR emergency response. The scenario building under new PMP/PMF is necessary for promoting the capacity of typhoon-related DRR among Members.
- The Project of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP), which was funded by ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and Southeast Asian Countries, Was successful implemented in 2013. It will greatly benefit the Members and the contribution form Members is also very important for achieving the goals of SSOP project.
- Enhancement of the close collaboration with the AWG of WMO CHy, WMO RA II Working Group on Hydrological Forecasts and Assessments and RA V Working Group on Hydrological Services in several themes of common interest provides significant benefits to the Committee.

Recommendations of WGH:

64) On the basis of the outcomes 2nd WGH working meeting and the discussion of the Parallel Session, the participants concurred to make the following recommendations to the TC Session to be held in Bangkok, Thailand from 10-13 February 2014.

- To appoint with augmentation Ms. LI Yan, Deputy Division Director, Bureau of Hydrology (BOH) of China as Vice Chairpersons of WGH.
- To allocate US$34,000 from TCTF in total for supporting overall WGH activities for 2014 calendar year.
- To approve WGH AOP1 extending one more year to 2014.
- To request WGH to continue the project of OSUFFIM as one of subsequent activities of TC cross-cutting project of UFRM and request Members of Pilot Cities exploring mobilization the self-funding support for the pilot studies of development and application of OSUFFIM.
- To request TRCG to consider the possibility of organizing roving seminar or training course for TC Members on urban flood forecasting, inundation mapping, PMP/PMF review and study taking into consideration climate change as subsequent activities of TC cross-cutting project of UFRM.
- To request Members of Pilot Cities exploring mobilization the self-funding support for the pilot studies and application of Xin'anjing model in selected river basins to promote the capacity of flood forecasting and warning.
- To request HRFCO, MOLIT of Republic of Korea to host WGH third working meeting in appropriate time with funding support.
- To request HRFCO, MOLIT of Republic of Korea to perfect WGH webpage and set up the linkage with TC website in cooperation with TCS and Members.
- To encourage Members to contribute TC cross-cutting project of SSOP.
- To re-appoint the hydrologist of TCS Mr. Jinping LIU and the focal point of WGH, Ms. Hwi-Rin KIM, Republic of Korea as the liaison to WMO RA II and RA V WGHs for the Committee.
- To request WMO continue taking actions to facilitate involvement of WGH in the activities of WMO water and hydrology issues.
- To request WGH continue taking the action on the closest linkages between the two working groups of WMO RAII and the Committee which were identified at the Committee 43rd Session as:
  - UFRM and flash flood/debris flow/landslide prediction/warning under the RA II theme of Disaster Mitigation – Implementation of the WMO Flood Forecasting Initiative including Flash Flood Forecasting Capabilities; and
  - Assessment of the variability of water resources in a changing climate under the RA II theme of Water Resources Assessment, Availability and Use (surface water and ground water).
- To request WGH 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 2013

Annex 2. Successor Indicators of WGH AOP 2014

Annex 1

WORKING GROUP on HYDROLOGY (WGH) - AOP 2013 Implementation Status

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources	Completed – Yes or No
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 5 SG 6b KRA 6 SG 6b	1	Assessment System of Flood Control Measures on Socio-economic Impacts	To develop the manual of ASFCM system and distribute to the TC members who want to apply the system		coordination	(a) First (b) Second (c) Third (d) Fourth		(a,b,c) To develop the system manual to help members' application of ASFCM in their own basins. (b,c,d) To consult the effect of the proposed flood control measures in selected basins	TCTF $2,000 for developing the manual	MLTM TCTF	(a,b,c) Yes (b,c,d) On going
KRA1 KRA 4 SG 4a SG 4bKRA5 SG 5a KRA 6 SG 6b	2	Extreme flood forecasting system	To develop the TC homepage for WGH members and investigate flood forecasting systems in the selected members		See above	(a) First (b) Second (c) Third (d) Fourth	RID of Thailand, PAGASA of Philippines Laos	(a,b) Development of the Korean and English version of TC homepage for WGH members (a,b) Development of the member's reports and data sharing page (b,c) Investigation of the current flood forecasting systems and operation conditions in the selected basins (b,c,d) Comparison of the flood forecasting systems of the selected members	TCTF $3,000 for the investigation	MLTM TCTF	(a,b) Yes (a,b) Yes (b,c) On going (b,c,d) On going
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	3	Project on estimation for socio-economic impact of sediment-related disaster	to improve former projects with establish common collecting format and methods of investigation for disasters to estimate estimation for socio-economic impact of sediment-related disaster and to share common technical background in TC members.	WGDRR	See above	(a)First (b)Second (c)Third (d)Fourth		(a) Providing a draft format to collect the record of sediment-related disaster (b) Deciding the format to collect the record of sediment-related disaster (c) To report the results of survey based on the format by each TC members (d1) To make a "Sediment-related Disaster Record Database" to share the records in TC members (d2) To report and share the results of estimation of socio-economic impact		NILIM SABO	(a)Yes (b)Yes (c)on going (d1)No (d2)No

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources	Completed – Yes or No
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	4	Development of Operational System forUrban Flood Forecasting and Inundation Mapping (OSUFFIM)	todevelop a prototype real time OSUFFIM for TC Members to promote the capacity of early warning of urban flood and emergency response, particularly urban flood forecasting and inundation mapping.		diver	(a)First (b)Second (c)Third (d)Fourth	SMG, Macao; Sun Yat-Sen University of China; TMD/RID of Thailand	(a1) kick-off meeting for discussion plan (a2) Survey of Pilot City—Hat Yai; (b1) Data collection, analysis and procession of the chosen pilot cities (Hat Yai) (b-c) developing system (d) report the progress at IWS	TCTF $6000 for supporting activities related to OSUFFIM development	STDF of Macao; SYS Univ. ; TMD/ RID of Thailand; TCTF	(a1) Yes with delay (a2) Postponed (b1) postponed (b-c) postponed (d)postponed
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	5	Extend application of Xin'anjiang Model in Selected River Basins in TC Members	To promote the Capacity of Flood Forecasting for TC Members; Use the Model in Pilot River basin in Malaysia in 2013		Coordination	(a)First (b)Second (c)Third (d)Fourth	BOH and Hohai University of China; DID of Malaysia	(a1) perfecting the English version of Model (China) (a2) select river basin and prepare necessary data by DID (b) Send profs/experts to Malaysia for training (c) Use the model on trial in flood season (d) report to TC IWS and Session	TCTF $2000 to support experts for training course in Malaysia	BOH of China; DID of Malaysia	(a1) yes (a2) yes (b)yes (c) on going, (d) on going
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	6	Guidelines for extreme flood risk management in TC region	To define the concept of extreme flood and host a workshop to develop the consensus about the guideline among the members		See above	(a) First (b) Second (c) Third (d) Fourth		(a) Development of the definition of extreme flood in TC region (b,c) preparedness of WGH meeting(workshop) for TC members to discuss about TC AOP including extreme flood risk management (c)host 2nd WGH Working meeting (b,c,d) Development of consensus about the contents in the guideline among the members	TCTF $2,000 for hosting the WGH meeting(workshop)	MLTM TCTF	(a) Yes (b,c) Yes (c) On going (b,c,d) No
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 5 SG 5a KRA 6 SG 6b	7	Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data	To study on prediction of debris flow and shallow landslide by the satellite rainfall data	WGDRR	See above	(a)First (b)Second (c)Third (d)Fourth	accept application	(b) kick-off meeting for discussion plan (c) accept proposal as pilot basin (d) Study on pilot basin	N/A	ICHARM	(b)No (c)on going (d)on going

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources	Completed – Yes or No
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a, SG 5a KRA 5 SG 5a SG 5b KRA 6 SG6b	8	Project of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP)	To develop a Manual/Handbook of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning Systems	WGM WGDRR TRCG	Coordination Focal Point	(a)First (b)Second (c)Third (d)Fourth	PTC, ESCAP, WMO, ADRC, IOC of UNESCO	(a) Workshop of SSOP (b) Piloting in selected countries (c-d) Drafting the Manual/Handbook of SSOP		ESCAP funding	(a) YES (b) on going (c-d) on going

SG1: To enhance cooperation among TC Members to reduce the number of deaths by typhoon-related disasters by half in the ten years of 2006 – 2015 (using the ten years of 1990 - 1999 as the base line).
SG2: To reduce the socio-economic impacts of typhoon-related disasters per GDP per capita by 20 per cent in the ten years of 2006- 2015 (using the ten years of 1990 - 1999 as the base line).
SG 3a: To identify and explore the beneficial use of resources such as rainfall brought by typhoon.
SG 3b: To study and promote the increasing use of typhoon-related beneficial effects among the Members.
SG 4a: To provide reliable typhoon-related disaster information for effective decision making in risk management in various sectors.
SG 4b: To strengthen capacity of the Members in typhoon-related disaster risk management in various sectors.
SG 4c: To enhance international and regional cooperation and assistance in the field of disaster risk reduction.
SG 5a: To promote and enhance culture of community-based disaster risk management among the Members.
SG 5b: To promote education, training and public awareness of typhoon-related disasters among the Members.
SG 6a: To facilitate RSMC capability to respond to the needs of the Members in forecasting and capacity building.
SG 6b: To improve capacity of Members to provide timely and accurate user-oriented and friendly tropical cyclone products and information.
SG 6c: To enhance capacity of Members' typhoon-related observation, monitoring, forecasting and warning.
SG 7a: To strengthen the capacity of Typhoon Committee to effectively discharge its responsibilities and functions described in this Strategic Plan and completed its stated mission in accordance with the Typhoon Committee's Statute.
SG 7b: To mobilize available resources and engage collaborators for the implementation of the strategic goals.

KRA 1: Reduced Loss of Life from Typhoon-related Disasters.
KRA 2: Minimized Typhoon-related Social and Economic Impacts.
KRA 3: Enhanced beneficial typhoon-related effects for the betterment of quality of life.
KRA 4: Improved Typhoon-related Disaster Risk Management in Various Sectors.
KRA 5: Strengthened Resilience of Communities to Typhoon-related Disaster.
KRA 6: Improved capacity to generate and provide accurate, timely and understandable information on typhoon-related threats.
KRA 7: Enhanced Typhoon Committee's Effectiveness, Efficiency and International Collaboration.

Annex 1

WORKING GROUP on HYDROLOGY (WGH) - AOP 2014

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 5 SG 6b KRA 6 SG 6b	1	Assessment System of Flood Control Measures on Socio-economic Impacts	To consultthe ASFCM application in TC regions		coordination	(a) First (b) Second (c) Third (d) Fourth		(a,b) To collect of the TC member's comments of the ASFCM technical report (a,b,c,d) To consult the effect of the ASFCM application in TC regions	TCTF $3,000 for application	MOLIT TCTF
KRA1 KRA 4 SG 4a SG 4bKRA5 SG 5a KRA 6 SG 6b	2	Extreme flood forecasting system	To operate the TC homepage for WGH members and design the extreme flood forecasting system		See above	(e) First (f) Second (g) Third (h) Fourth	RID of Thailand, PAGASA of Philippines Laos	(a,b,c,d) To operate the TC WGH homepage and collect of the TCmember's comments of the homepage (d) To amend the TC WGH homepage (c,d) To design the extreme flood forecasting system	TCTF $3,000 for the investigation	MOLIT
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	3	Project on estimation for socio-economic impact of sediment-related disaster	to improve former projects with establish common collecting format and methods of investigation for disasters to estimate estimation for socio-economic impact of sediment-related disaster and to share common technical background in TC members.	WGDRR	See above	(a)First (b)Second (c)Third (d)Fourth		(a) Providing a draft format to collect the record of sediment-related disaster (b) Deciding the format to collect the record of sediment-related disaster (c) To host SABO workshop (d1) To make a "Sediment-related Disaster Record Database" to share the records in TC members (d2) To report and share the results of estimation of socio-economic impact	TCTF $3500 for SABO Workshop	MLIT NILIM SABO TCTF

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	4	Development of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM)	To develop a prototype real time OSUFFIM for TC Members to promote the capacity of early warning of urban flood and emergency response, particularly urban flood forecasting and inundation mapping.		diver	(a)First (b)Second (c)Third (d)Fourth	Sun Yat-Sen University of China; RID of Thailand	(a1) set up of national working group (a2) Survey of Pilot City in Thailand and China (b1) Survey of Pilot Cities in Malaysia (b-c1) Data collection in pilot cities (b-c2)Chinese version development (c-d1) implementation in China (c-d2)technical material preparing (d3) report the progress at IWS	TCTF $6000 for supporting activities related to OSUFFIM development	SYS Univ. ; RID, Thailand; DID, Malaysia NHMS, Vietnam TCTF
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	5	Extend application of Xin'anjiang Model in Selected River Basins in TC Members	To promote the Capacity of Flood Forecasting for TC Members; Use the Model in Pilot River basin in Malaysia in 2013		Coordination	(a)First (b)Second (c)Third (d)Fourth	BOH and Hohai University of China; DID of Malaysia	(a-b)Application of Xinanjiang model for Segamat River (a-b) Improve English version of Model. (b-c) On-Job-Training course (b-c) Application of model for another selected river (b-c) Report on trial in flood season (c-d) Test run with the help of experts for new river (d) Project report at IWS and Anunal Session	$5500	TCTF BOH, China DID, Malaysia
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 6 SG 6b	6	Guidelines for extreme flood risk management in TC region	To develop the flood control measures for extreme flood and host a workshop to develop the consensus about the guideline among the members		See above	(a) First (b) Second (c) Third (d) Fourth		(a,b) Development of consensus about the contents in the guideline among the members (b,c) preparedness of WGH meeting(workshop) for TC members to discuss about TC AOP including extreme flood risk management (c)host WGH Working meeting (b,c,d) To develop the structural & non-structural flood control measures for extreme flood	TCTF $3,000 for hosting the WGH meeting(workshop)	MOLIT TCTF
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a KRA 5 SG 5a KRA 6 SG 6b	7	Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data	To study on prediction of debris flow and shallow landslide by the satellite rainfall data	WGDRR	See above	(a)First (b)Second (c)Third (d)Fourth	accept application	(a-d) Developing Prototype system (ICHARM) (a-d) Correcting ground truth data on test fields (a-d) Analyzing on test fields (c-d) Workshop on test fields	N/A	PWRI/ICHARM

SP's KRA and SG	Objective Number	Objective	Action	Other WGs Involved	TCS Responsibility	Expected Quarter Completed	Other Organizations Involved	Success Indicators	Funding Required	Funding Sources
KRA 1 SG 1 KRA 2 SG 2 KRA 4 SG 4a, SG 5a KRA 5 SG 5a SG 5b KRA 6 SG6b	8	Contribution to the development of SSOP Manual and SSOP Training	(a) To review and comment on the SSOP Manual and related Documents (b) To review and provide input into planned SSOP Training	WGH WGDRR TRCG	1st -4th	TCS, Members, ESCAP WMO PTC ADPC ABU	Seven beneficiary Members	NO	SSOP Budget	Project Manager, Steering Committee, and Task Team

SG1: To enhance cooperation among TC Members to reduce the number of deaths by typhoon-related disasters by half in the ten years of 2006 – 2015 (using the ten years of 1990 - 1999 as the base line).
SG2: To reduce the socio-economic impacts of typhoon-related disasters per GDP per capita by 20 per cent in the ten years of 2006- 2015 (using the ten years of 1990 - 1999 as the base line).
SG 3a: To identify and explore the beneficial use of resources such as rainfall brought by typhoon.
SG 3b: To study and promote the increasing use of typhoon-related beneficial effects among the Members.
SG 4a: To provide reliable typhoon-related disaster information for effective decision making in risk management in various sectors.
SG 4b: To strengthen capacity of the Members in typhoon-related disaster risk management in various sectors.
SG 4c: To enhance international and regional cooperation and assistance in the field of disaster risk reduction.
SG 5a: To promote and enhance culture of community-based disaster risk management among the Members.
SG 5b: To promote education, training and public awareness of typhoon-related disasters among the Members.
SG 6a: To facilitate RSMC capability to respond to the needs of the Members in forecasting and capacity building.
SG 6b: To improve capacity of Members to provide timely and accurate user-oriented and friendly tropical cyclone products and information.
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SG 7a: To strengthen the capacity of Typhoon Committee to effectively discharge its responsibilities and functions described in this Strategic Plan and completed its stated mission in accordance with the Typhoon Committee's Statute.
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