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AND  
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FOR PARTICIPANTS ONLY

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Hong Kong, China

**Report of Cross-cutting Project on Urban Flood Risk Management (UFRM) in TC Area**

(Item 7 of Provisional Agenda – Cross-cutting Project)

(Submitted by TCS)

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**ACTION REQUIRED:**

This Committee is invited to:

- a) Review the activities and progress of UFRM
- b) Take note the final version of UFRM Guidelines to be published after 45<sup>th</sup> Session

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**APPENDIX:**

- I. Final version of UFRM Guidelines

## **REPORT OF THE CROSS-CUTTING PROJECT ON URBAN FLOOD RISK MANAGEMENT (UFRM) IN TC AREA**

The cross-cutting Project on Urban Flood Risk Management (UFRM) in Typhoon Committee Area is led by China as first cross-cutting project lasting from 2008 to 2012. In the past years, the committee gave its very close attention and strong support to the implementation of this project. All Members of pilot cities, working groups on meteorology (WGM), hydrology (WGH), disaster prevention and preparedness (WGDRR) and Training and Research Coordination Group (TRCG) made very close cooperation and very strong support, AWG Members of TC, ESCAP and WMO provided constructive guidance and advice to the project.

The project will be closed after TC 45<sup>th</sup> Session. The report intended to briefly record the development of the project, to summarize the outcomes and achievement of implementation, and to comment on the further activity in the aspects of UFRM for TC Members.

### **1. THE INITIATIVE OF THE PROJECT ON UFRM**

Economic growth and urbanization are inextricably linked. Economic growth often implies the conversion of rural land to urban uses, massive inflows of capital transformed and more people concentrated in urban areas. An important effect of urbanization is to increase the sensitivity of urban watersheds to the distribution of short-duration rainfall rates and flood. That creates much larger potential flood-related damage especially in the Asia and the Pacific region influenced by typhoon. A successful 'urban flood mitigation and management' requires proper understanding of the problem, long-term planning, availability of resources for taking immediate action during flood events and coordination between different public and private agencies.

In this connection, to promote the capability of urban flood mitigation and management, WGH took an initiative to consider the proposal of the ***Project on the Management of Floods in Urban Area*** on its thirty-ninth session held in Manila, Philippines, from 4 to 9 December 2006.

The Project was proposed to be carried out with the objectives as following:

- To exchange the experiences on management and mitigation of floods and typhoon-related disaster in urban area between TC Members;
- To share the technology of urban flood monitoring and methodology of urban flood forecasting and prediction, early warning and disaster assessment between TC Members; and
- To promote management of urban flood and other typhoon-related disasters in TC area.

The expected achievement of the project was proposed to prepare and publish the ***"Guidelines on flood mitigation and management for urban planning and development in the Typhoon Area"***.

WGH made following conclusions at TC 39<sup>th</sup> Session:

- China prepares the detail proposal and road map as leading country of the

project.

- The Guidance from ESCAP and WMO, and the cooperation of TC Members and all TC working groups (WGM, WGH, WGDPP, TRCG, AWG and RMG) are indispensable to carry out the project successfully and fruitfully, considering its complicity and comprehensiveness.

At TC second Integrated Workshop on Social-economic Impacts of Extreme Typhoon-related Events, which was held in Bangkok, Thailand from 10 to 14 September 2007, the participants reviewed and discussed the proposal and road-map reported by China, and concurred that it is very important and necessary for TC members to enhance the cooperation and research on urban flood disaster management. The participants also recognized this project would be the first one to integrate WGM, WGH, WGDPP and TRCG into one project. Considering the urban flood management relates to meteorology, hydrology and disaster prevention and preparedness and other aspects, the title of the project was advised as current '**Urban Flood Risk Management in Typhoon Committee Area**'.

## 2. MAJOR FOOTPRINTS OF UFRM PROJECT

The project made progresses toughly in the past years and achieved its goals gradually. The major footprints are briefly recorded as below:

### — TC 3<sup>rd</sup> Integrated Workshop with the theme of Coping with Climate Change in the Typhoon Committee Area, held in Beijing, China from 22 to 26, 2008

At this workshop, WGH decided to officially launch the project of UFRM as its one of AOPs and proposed the draft road-map for approval of TC Session.

Month/Year	Action	Participant
Oct. 2008~April 2009	<ul style="list-style-type: none"> <li>• Questionnaire Survey of emerging issues to ESCAP, WMO, and WGs</li> <li>• Inter-sectoral small meeting</li> </ul>	By China and interested TC Members
Feb. 2009 ~Sept. 2009	<ul style="list-style-type: none"> <li>• Collection of information including in questionnaire</li> </ul>	By TC Members
May. 2009~Sept. 2010	<ul style="list-style-type: none"> <li>• Pilot study of urban flood disaster impact assessment by using ECLAC</li> </ul>	By TC Members
	<ul style="list-style-type: none"> <li>• Pilot Research of P~R mechanism in urban area</li> </ul>	By China, .....
	<ul style="list-style-type: none"> <li>• Compilation of collected information and results of pilot study and research</li> </ul>	By Working Groups
Oct. 2010~ Sept. 2011	<ul style="list-style-type: none"> <li>• Preparation of the guidelines of urban flood management in typhoon area.</li> </ul>	By Working Groups
Dec. 2011	<ul style="list-style-type: none"> <li>• Issuing the guidelines</li> </ul>	By TC

### — TC 41<sup>st</sup> Session held in Cheng Mai, Thailand from 19 to 24 January 2009

At the Session, the Committee welcomed the plans of the WGH and endorsed the "Project on Urban Flood Management in TC region", with possibilities to enlarge its scope to

be tackled as joint project of the three WGs.

The WGH emphasized the importance of cooperation among WGs and TC Members, and requested the Committee to seek funds for this valuable project. China proposed the following activities for the expected achievement:

- survey of emerging issues in the Committee Area joint-organized by ESCAP, WMO and TC;
- collection and compilation of experiences on management and mitigation of floods and typhoon-related disaster in urban areas among the TC Members;
- collection and compilation of technology and methods on monitoring and early warning of urban floods and typhoon-related disaster among the TC Members;
- pilot study of urban flood disaster impact assessment by using ECLAC;
- Joint research of rainfall~runoff mechanism in urban area by TC Members;
- regional cooperation including possibility to collaborate with ICHARM to prepare for the Asia-Pacific Water Summit;
- ESCAP expressed the possibility to provide 5000USD for consultancy of UFRM project.

— **TC 4<sup>th</sup> Integrated Workshop with the theme of Building Sustainability and Resilience in High Risk Areas of the TC: Assessment and Action, held in Cebu, Philippines from 14 to 18 September, 2009**

At the Workshop, the progresses of the project were reported:

- China submitted the report of questionnaire survey among TC Members with four findings;
- WGH decided to set up a task force consisting of Chairs/vice-chairs of WGs, representatives from ICHARM, ESCAP, TCS, China and Philippines in order to advice and give guidance to driver of UFRM and to link with other WGs and international organizations;
- WGH discussed the possibility to conduct the project on Metro Manila Integrated Pilot Study. PAGASA will prepare the proposal for TC Annual Session.
- WGH requested 4,000USD TCTF for supporting 4 persons participating in the 2-day WGs joint task force meeting for the Project of UFRM in Macao, China in May/June 2010.

— **WGH Teleconference on UFRM Project, held on December 9, 2009**

WGH held teleconference on SKYPE to discuss how to organize and the priority activities for pushing the the cross-cutting project. The main outcome includes:

- Project Organizing
  - to set up national task force in the priority pilot cities.
  - to set up TC task force and to integrate the three components of TC Work: WGM, WGH and WGDPP.
  - to be led by AWG and facilitated by TCS.
  - to be linked with ESCAP, WMO, ICHARM and other international organizations for the mobilization of the expertise resources and funding resource.

- to involve all TC Members, especially under-developing Members, such as Cambodia, Lao PDR and DPRK with focus on hydrology and water resources.
- to be led by Ministry of Water Resources of China as driver in the field of hydrology.
- Proposed Priority Activities
  - to compile key and common urban flood problems in TC Area.
  - to find good practices or on-going projects regarding the urban flooding and to exchange the experience and technique among TC Members.
  - to identify the criteria for selection of priority pilot cities, which can represent different types of city such as coastal city, mountainous city, river-along city, plain city, etc.
  - to select the priority pilot cities in TC region, based on abovementioned criteria.
  - to work out executable roadmap.
  - to identify the concrete outputs and achievements on its work to improve water resources management and understanding of the hydrological cycle of the TC Area including impacts of climate change on urban development.
  - to develop a decision-making support system for urban flood management including design and rationality verification of rain gauge network, Radar data application, flood monitoring and reporting, flood forecasting, early warning, hazard mapping, etc.
  - to prepare the report and training materials for possible replication which can be supported by ICHARM.
  - to identify the required supporting activities expected from WGM and WGDPP for effective innovative urban flood risk management for priority pilot cities.
  - to study the possible impacts of climate change on hydrology and flood regime for priority pilot cities.
  - to be supported by ICHARM on the terms of the technique of down-scaling calculation of meteorology data and various networks with researchers/flood managers.

**— The small meeting of WG chairs (AWG), held in Macao, China from 16 to 17 December 2009**

AWG members discussed the outcome of WGH teleconference and there was a consensus in considering the UFRM proposed by China as a crosscutting project, involving the three main components of TC and agreed in general with the project proposal. It was also proposed that AWG be given the responsibility of managing this project.

The AWG requested other WGs to review the proposal and provide their input. The suggestion of setting up a task force (or coordinating body) was supported, and some suggestions regarding joining efforts of the WGs on working together were advised:

- Creation of a task force;
- Establishment of the criteria for the selection of a pilot city for the project;
- Need of choosing high risk cities as pilot cities (several cities were mentioned: Beijing, Busan, Macao, Manila, city in the coast of Viet Nam);
- Include also storm surge in the project, combining river floods and storm

- surges;
- To organize a meeting in July or August 2010, to be supported by ESCAP, to discuss the UFRM project;
- Take the possibility of contracting consultants by ESCAP to push forward this crosscutting project (about US\$5,000 from ESCAP)
- To set up roadmap that would include detailed implementation procedures and financial aspects;
- ESCAP expressed its willingness to contact donors for since this project is properly structured;
- To set up the channel of connection and communication with support base, such as ESCAP, WMO, ISDR, WB, ADB, ICHARM, JICA, etc;
- Discuss the roadmap for this project at 42ndTC Session

Metro-Manila was considered a potential pilot city for the TC crosscutting UFRM project at the AWG small meeting.

— **TC 42<sup>nd</sup>Session, held in Singapore from 25 to 29 January 2010**

At the Session, the Committee made the following decisions regarding UFRM project:

- To confirm UFRM project as cross-cutting project of TC
- To set up a special Task Force for Coordination Body to manage the implementation of the cross cutting project of UFRM in order to coordinate its implementation efficiently.
- To allocate US\$ 4,000 from TC Trust Fund and organize the WGs joint meeting on UFRM as one of the AWG activities.
- To survey 3 Members (China, Japan and R. of Korea) as good practice on UFRM (Side meeting)
- To build strong linkage with ESCAP and WMO to push forward the UFRM project.
- To consult with ICT and DRR Division of ESCAP regarding the possibility to organize a meeting in July or August 2010 to be funded by ESCAP to discuss the UFRM project and the possibility of contracting consultants by ESCAP to push forward this cross cutting project.
- To set up the channel of connection and communication with support base of UFRM project, such as ESCAP, WMO, ISDR, WB, ADB, ICHARM, JICA, etc.

— **Expert (Task Force) Meeting, held in Bangkok, Thailand from 19-20 July, 2010**

Following TC AOP, an expert meeting on UFRM (TC Task Force meeting), named strengthening regional cooperation towards flood resilient cities considering climate change: ESCAP/WMO Typhoon Committee Meeting on Urban Flood Risk Management Project (UFRM), was held in Bangkok on, supported by ESCAP Information and Communications Technology and Disaster Risk Reduction Division (IDD).

Remarkable progresses were achieved at the meeting:

- proposed the structure for implementation of UFRM project;
- established Task Force and proposed its Terms of Reference (TOR);
- nominated four pilot cities and the contact persons initially;
- Suggested to seek the further technical cooperation or funding support from UN agencies, international organizations, private companies or individuals as

- Support Groups;
- invited Shanghai (China), Yokohama (Japan) and Busan (Republic of Korea) to provide good practice to pilot cities;
- proposed the timeline of UFRM project
- confirmed to contract consultant for UFRM project with funding support from ESCAP.

— **TC 5th Integrated Workshop on Urban Flood Risk Management in a Changing Climate: Sustainable and Adaptation Challenges, held in Macao, China from 6 to 10 September 2010**

The Committee set UFRM as the theme of this workshop. The progresses were indicated as:

- summarized the good-practice provided by China, Japan and Republic of Korea;
- confirmed HatYai, Thailand; Metro Manila, Philippines and Hanoi, Viet Nam as 3 pilot cities for UFRM project;
- decided to conduct Task Force Mission to 3 pilot cities;
- discussed the activities and approaches to conduct pilot study and consultancy.

— **TC 43<sup>rd</sup> Session, held in Jeju, Republic of Korea from 17 to 22 January 2011**

At the Session, the committee made following decisions on the base of recommendations of WGH and Task Force of the project:

- to extended one or more years considering that the project is very important and has many different tasks to complete even though substantial progress has been achieved in past years;
- to request strong collaboration of 3 working groups, AWG and Task Force and close linkage with WMO and ESCAP to push forward the project UFRM;
- to request the ICT and DRR Division of ESCAP to fund and organize a meeting in July or August 2011 to review the consultancy, to discuss the implementation of pilot study and the preparation of the final guidelines of the UFRM project;
- to set up the channel to link the TC cross-cutting project of UFRM with the agencies of City-Net and ISDR;
- to assign to TF Members the responsibility of providing expertise guidance and advice to UFRM implementation:
  - the Chair of WGM Mr. Xiaotu LEI and Director of RSMC Mr. Masashi KUNITSUGU to take care of meteorological aspect
  - Chair and Vice-Chairs of WGH Mr. Minoru KAMOTO, Dr. Zhiyu LIU and Dr. Yang-soo KIM to take care of hydrological aspect
  - Chair and representatives of WGDRR, Dr. Sang Man JEONG, Dr. Tae Sung CHEONG and Ms. Hilda LAM to take care of DRR aspect
- to request WGM, WGH and WGDRR to consider how to combine their activities with and contribute to the TC cross-cutting project of UFRM;
- to call on Members to provide training and expertise on QPE/QPF, hydrological/hydraulic modeling and inundation mapping for UFRM pilot

- project as in-kind contribution;
- to request TF through TCS to issue invitation letters to the Members to provide the experts for training and assistance for UFRM pilot project;
- to request the Members of Pilot Cities to explore mobilization the self-funding support for the pilot studies;
- to request TCS to include a request for Kuala Lumpur to be one of pilot cities in the UFRM project in the letter of appreciation regarding OJT to the Director General of the DID Malaysia;
- to allocate \$9,000 USD TCTF for supporting UFRM project related activities.

— **TC 6<sup>th</sup>Integrated Workshop on Damage Assessment Methodology and Pre-assessment of Typhoon Landfall Impacts, held in NhaTrang, Viet Nam from 7 to 11 November 2011**

At the Workshop, the Committee reviewed the implementation status and proposed activities as follows:

- to initiate developing OSUFFIM in case the STDF of Macao, China approved the proposal submitted by SMG, Macao and TCS;
- to start to conduct the case Study on QPE/QPF Application in UFRM in cooperation with WGM;
- to continue to conduct the training raining for pilot-city Members on QPE/QPF application, flood inundation mapping and flood disaster assessment;
- to continue to conduct pilot study in Pilot cities;
- to conduct the UFRM Workshop, funded by ESCAP to be held in March, 2012 (TBC)
- to start drafting UFRM Guidelines and to hold a drafting meeting.

— **TC 44<sup>th</sup>Session, held in Hangzhou, China from 6 to 11 February 2012**

At the Session, the Committee reviewed the progresses made in the past year and decided:

- to continue assigning to TF Members the responsibility of providing expertise guidance and advice to UFRM implementation:
  - the Chairperson of WGM Mr. Xiaotu LEI and Director of RSMC Mr. Masashi KUNITSUGU to take care of meteorological aspect;
  - Chairperson and Vice-Chairpersons of WGH Mr. Minoru KAMOTO, Dr. Zhiyu LIU and Dr. Yang-soo KIM to take care of hydrological aspect;
  - Chairperson and representatives of WGDRR, Dr. Tae Sung CHEONG, Mrs. Hilda LAM and Ms. Fong Peng LEONG to take care of DRR aspect.
  - Chairperson of TRCG, Mr. Edwin LAI to take care of the training and education of UFRM.
- to request WGM, WGH and WGDRR continue considering how to combine their activities with and contribute to the TC cross-cutting project of UFRM;
- To request Members continue providing the training and expertise on QPE/QPF, hydrological/hydraulic modelling, inundation mapping and flood disaster assessment for UFRM pilot project as in-kind contribution;
- to request the Members of Pilot Cities continue exploring mobilization the



- self-funding support for the pilot studies;
- to request strong collaboration of the three working groups, AWG and TF and maintain close linkage with WMO and ESCAP to push forward the project UFRM.
- to request WGH conduct case study on real-time QPE/QPF application in UFRM pilot study, in cooperation with WGM;
- to request TRCG continue coordinating with WGH when planning related matters training and research;
- to allocate \$10,000USD TCTF for supporting UFRM project related activities;

— **TC7<sup>th</sup>Integrated Workshop on Effective Warning, held in Nanjing, China from 26 to 30 November 2012**

The Committee reviewed the activities related to UFRM in 2012 and the third version of UFRM Guidelines and decided:

- to request Pilot Cities providing the pilot study report;
- to publish the final version of UFRM Guidelines after 45th Session.

### **3. SUMMARY OF MAIN IN-KIND CONTRIBUTION TO UFRM**

During the thorough period from 2006 to 2012, TC WGs, UFRM Task Force members and TC Members, particularly the Members of UFRM pilot cities contributed greatly to the implementation of TC Cross-cutting project of UFRM.

The main drafters of UFRM Guidelines coming from China; Japan; Hong Kong, China; Philippines and Republic of Korea contributed their valuable time and expertise. The Task Force Members (Chairs/vice chairs of WMG, WGH, WGDRR and TRCG) contributed their expertise and constructive advice to the project implementation. ESCAP and WMO provided very important guidance and support, particularly the consultancy and workshops funded by ESCAP. TCS has been providing the conscientious coordination for this project since very beginning.

The in-kind contributions in both aspects of finance and expertise from TC Members were summarized briefly as below:

— **China**

- worked for the project as the leading country;
- contributed Shanghai as one of good practice cities for the project;
- provided Guangzhou as one of UFRM pilot cities;
- hosted 2-day UFRM working meeting in April 2011;
- organized and facilitated the UFRM good practice city visiting in Shanghai in May 2011;
- conducted UFRM on-job-training on QPE/QPF operation in Shanghai for staffs of TMD, Thailand in 2011;
- provided experts for UFRM training on urban flood inundation mapping and flood forecasting carried in Thailand in August 2011;
- organized and compiled the Guidelines drafting;
- hosted 2-day Guidelines drafting meeting in Nanjing in February 2012;
- hosted 3-day UFRM training course in Guangzhou for pilot cities in

September 2012.

— **Japan**

- Worked for the project as the head of Task Force;
- Provided Yokohama as one of UFRM pilot cities;
- Supported the UFRM expert meeting held in Bangkok in July 2010;
- Supported the UFRM workshop held in Macao in 2012.

— **Macao, China**

- Provided funding support to TC hydrologists for participating in UFRM Session of the WMO 7<sup>th</sup> SSWS workshop held in Macao in 2011;
- Provided funding support to TC hydrologists for participating in UFRM Workshop linked with ESCAP workshop on Applications of Space Technology to Enhance the Activities of the Typhoon Committee in 2012.

— **Malaysia**

- Provided Kuala Lumpur as one of UFRM pilot cities;
- Hosted the Roving Seminar on QPE/QPF linked with UFRM project in 2011.

— **Republic of Korea**

- contributed Ansong city as one of good practice cities for the project;
- organized and facilitated the UFRM good practice city visiting in Ansong Stream in 2011;
- provided expert for the training on Flood Disaster Assessment for UFRM pilot study in Thailand in 2011.

— **Philippines**

- Provided Metro-Manila as one of UFRM pilot cities;
- Arranged and facilitated the UFRM TF Mission in Metro-Manila in 2010;
- Self-funded 2 PAGASA weather forecasters participating in the QPE/QPF on-the-job training in Malaysia in 2011.

— **Thailand**

- Provided Hat Yai as one of UFRM pilot cities;
- Arranged and facilitated the UFRM TF Mission in Hat Yai in 2010;
- Self-funded total expenses for the UFRM on-job-training on QPE/QPF operation in Shanghai in 2011;
- Self-funded the local expenses for lecturers for the UFRM training carried in Bangkok in 2011.

— **Vietnam**

- Provided Hanoi as one of UFRM pilot cities;
- Arranged and facilitated the UFRM TF Mission in Hanoi in 2010.

#### **4. MAIN ACHIEVEMENTS OF UFRM PROJECT**

As the first cross-cutting project, the implementation of UFRM project brought the

obviously benefit to the Committee, including the aspects of technology and visibility. The achievement and outcomes would be used not only in TC Members but also in outside of TC area.

In general, the main outcomes of the project could be summarized as following six aspects.

— **Provided and accumulated the experience for the Committee on how to carry on the cross-cutting project in the Committee**

Via conducting this first cross-cutting project in the Committee, it is recognized that:

- The close cooperation among Working Groups and the Members could not be emphasized more;
- A powerful coordination body (steering committee) at TC level (AWG) is vitally important to carry on the cross-cutting issues successfully;
- Necessary funding support and in-kind contribution is the corner-stone of the success of cross-cutting project in the Committee;
- The tangible and feasible implementation plan is the premise of success for the cross-cutting project.

— **Summarized and abstracted the good practices in TC area on urban flood risk management**

On the base of information from three good-practice cities, five key common points for UFRM were abstracted as:

- To establish the comprehensive urban flood management strategy;
- To highlight the land use planning;
- To enhance meteor-hydrological monitoring, forecasting and warning to provide timely, accurate and all-sided information support to the urban flood management;
- To apply flood hazard/risk map widely as an important technique of urban flood preparedness;
- To emphasize on the function of retarding basins and discharge ponds in the urban flood management;
- To build up various dissemination ways of flood warning information to individual residents.

— **Identified the main gaps and needs in TC Members on urban flood risk management in aspects of hydrology, meteorology and disaster prevention and preparedness**

On the base of the Task Force Mission in three pilot cities and the study of good practice in China, Japan and Korea, the conclusions were remarked:

- Urban flood risks keep an increasing trend in the developing countries in the Asian-Pacific region.
- The priority task at the current stage is to restrain the urban flood risk from rising.
- It is necessary to learn a lesson from the bitter experience of a whacky circle.
- The features of flood risks in pilot cities are being changed due to the rapid urbanization and human activities in the river basins.

- The safety and reliability of the flood monitoring system, and the renewable and maintainable software systems are needed to enhance the capacity of urban flood management.
- Structural measures for flood control and drainage are still key measures to reduce flood risk especially in urban areas at present stage for most of the cities in the developing countries
- The technique training and cooperation on QPE/QPF operation, flood forecasting using QPE/QPF results, inundation mapping and disaster assessment were required hankeringly by pilot cities.

— **Trained the staffs and transferred the technique for TC Members on QPE/QPF application, urban flood inundation mapping and disaster assessment**

During the whole period of the project, a series of activities were conducted:

- Totally 7 training courses/workshops and 3 visiting/surveys were involved in UFRM project and over 150 participants from TC Members attended UFRM trainings;
- The technique and skill of QPE/QPF operation and application, urban flood forecasting and inundation mapping, and disaster assessment were transferred to the Members of pilot cities, particularly Thailand.

— **Drafted the UFRM Guidelines for TC Members**

The final version of UFRM Guideline is ready for publishing. The Guidelines will be distributed to all TC Members, international organizations/agencies, and other countries of regional bodies of WMO. The contents of the final version include:

- Introduction
- Framework of Urban Flood Risk Management
- Meteorological Monitoring and Rainfall Forecasting
- Urban Flood Monitoring, Forecasting and Warning
- Disaster Risk Management for Urban Floods
- Flood risk analysis and assessment
- Decision Support System for UFRM
- Training and research in support of UFRM
- Conclusion and Way Forward

— **Enhanced the visibility of the Committee in a sense**

As the cross-cutting project of the Committee, UFRM project was invited to be introduced and discussed on many occasions of international/regional workshops/seminars, which is definitely helpful to promote and enhance the visibility of the Committee in a sense, such as:

- The Integrated Workshops and Annual Sessions of TC since 2007;
- 5<sup>th</sup> and 6<sup>th</sup> WGDRR working meeting, respectively held in 2010 and 2011 in Seoul, Korea;
- The Regional Workshop on ICT Application for Disaster Risk Reduction and Sustainable Economic Development, held in Astana, Kazakhstan by UN ESCAP from 28-30 September 2011;
- The International Workshop of Applied Hydro-meteorological Research

Institute (AHMRI) of the Nanjing University of Information Science & Technology (NUIST), held in Nanjing, China from October 15 to 16, 2010

- WMO RA-II (Asia) Working Group on Hydrology (WGH), held in Seoul, Republic of Korea from 23 to 26 November 2010;
- The Workshop on Strengthening Regional Cooperation Towards Flood Resilient Cities Considering Climate Change: ESCAP/WMO Typhoon Committee Meeting on Urban Flood Risk Management Project (UFRM), held in Bangkok, Thailand from 19 to 20 July, 2010;
- the Workshop on Developing Capacity for Resilience to Water-Related Disasters in Pakistan through Space Applications and Flood Risk Management, held in Islamabad, Pakistan by UN ESCAP from 1 to 4 March 2011;
- The Seventh WMO TCP/JCOMM Workshop on Storm Surge and Wave Forecasting, held in Macao, China from 10 to 14 October 2011;
- The Workshop on Applications of Space Technology to Enhance the Activities of the Typhoon Committee, jointly organized by UN ESCAP and TCS, from 27 February to 2 March 2012 in Macao, China;
- International Seminar on Extreme Hydro-meteorological Events over Consideration of Global Climate Change held in AHMRI/COHM of NUIST, Nanjing, China from 9 to 10 May, 2012.

## 5. FURTHER ACTION ON UFRM

The finalizing the cross-cutting project on UFRM, does not mean the end of research on urban flood risk management in the committee. Actually, there are many topics on the aspect of UFRM still exiting and waiting for further action.

To meet the requirement of pilot cities, WGH proposed a new project (AOP) for 2013 and beyond, named ***Development of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members***, as the consequent activity of TC Cross-cutting Project of UFRM.

To promote the capacity of early warning of urban flood and emergency response, particularly urban flood forecasting and inundation mapping, Typhoon Committee Secretariat (TCS) and Macao Meteorological and Geophysical Bureau (SMG) proposed this project. This project was proposed to be lasted from 2013 to 2016.

The objectives of the proposal were supposed as:

- to carry on the research on the Key technique points existed in UFRM project;
- to develop a real time Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for Typhoon committee.

The Science and Technology Development Fund (STDF) of Macao Government decided to provide partial grant to support the development of “OSUFFIM”. Sun Yat-Sen University of China is willing to contribute this activity for Typhoon Committee based on its existing achievement on urban flood inundation mapping and possibly to merge their own potential budget to cover the shortage of the funding for development of OSUFFIM.

- This project will be jointly driven by SMG of Macao, China and TCS.
- As cooperation partner, Sun Yat-Sen University of China will develop the OSUFFIM in one pilot city in the period of 2013 and 2014.

- The OSUFFIM is proposed to be applied in selected interesting Members gradually from 2014 to 2016.
- TMD and RID of Thailand expressed their willing to have the strong cooperation and support to the project.
- Based on the communication with Focal Points of UFRM, YatHai of Thailand was selected as the pilot city for this project in 2013.
- TCS and SMG of Macao will draw up the detail implementation plan for 2013 in cooperation with Thailand and SunYat-SenUniversity.