

WGH Report



Site Visit to a
Water Level
Digital Board
of RID
Regional
Office in
Chiangmai on
7th Nov.

ESCAP/WMO Typhoon Committee, 2018

WGH Parallel Session during the 13th IWS 6th and 7th November, 2018

31 participants in total, including delegates from 11 Members

(China; DPR Korea, Japan; Hong Kong, China; Laos; Malaysia; the Philippines; RO Korea; Thailand, USA and Viet Nam), and hydrologist of TCS

Contents;

1. Review Members' Reports on hydrological activities in 2018;
2. Review the 7th working meeting of WGH;
3. Review the implementation status of WGH AOP 2018;
4. Discuss the implementation plan of WGH AOP and budget request for 2019;
5. Finalize the proposal of Chairmanship for WGH;
6. Recommendations to the Committee

1. Review Members' Reports on hydrological activities in 2018 Disasters in 2018



Sepian – Senamnoy Dam Break (23/07/2018)



Smashed windows and glass curtain walls



(Photo courtesy of Y W Ng, Man Kam Hoo, and Stephanie Lo)

Levee breach (left-side Levee at 3k400)

- The left-side levee of Oda River collapsed at 3k400 and the levee also collapsed at two locations of a tributary, Takama River (managed by the prefecture)



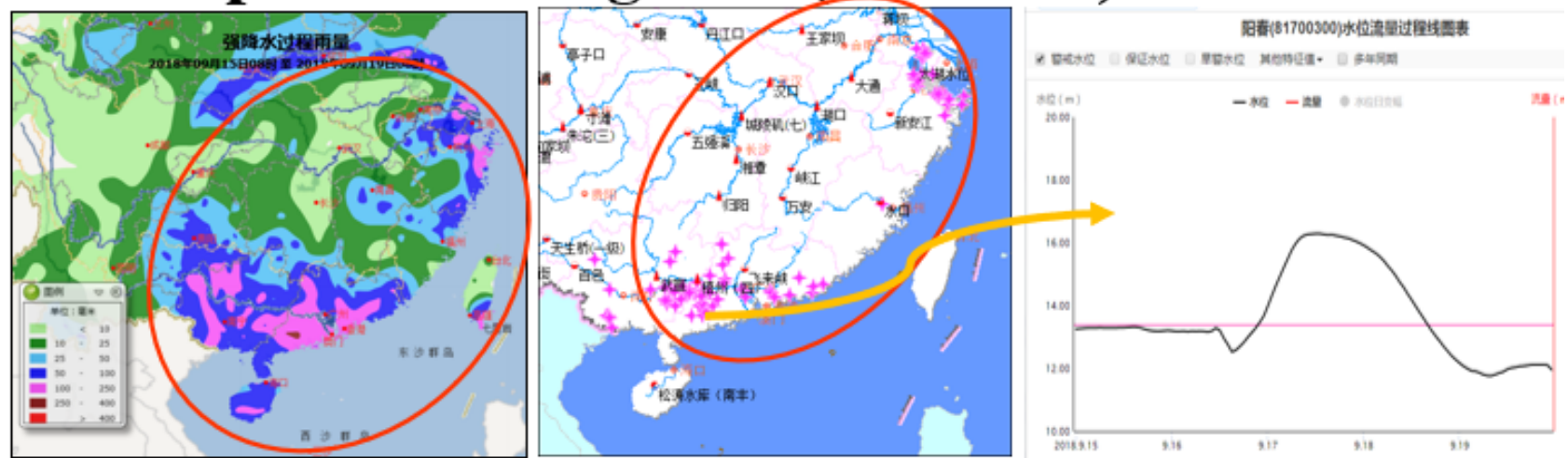
map in Kurashiki city





Hydrological Assessment

■ Super TY Mangkhut (No. 1822)



Rainfall and floods caused by Mangkhut

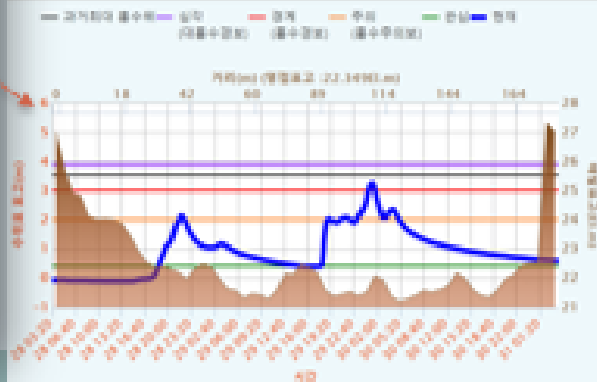
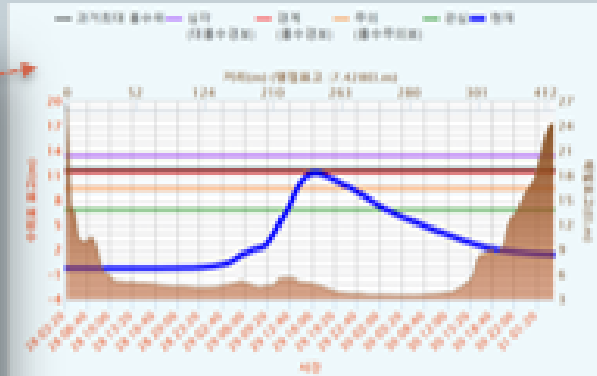
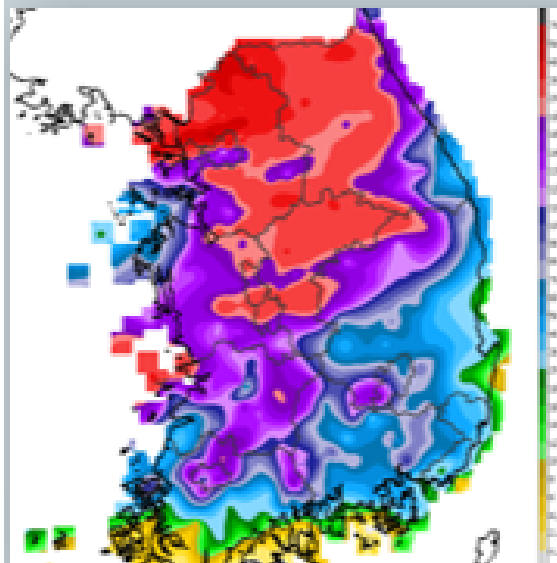
- The maximum accumulated rainfall amounted to **508 mm**.
- **89** small and medium sized rivers reported floods exceeded warning level.
- The return period of Moyangjiang flood is more than 30 years.



2018 Floods and Water management

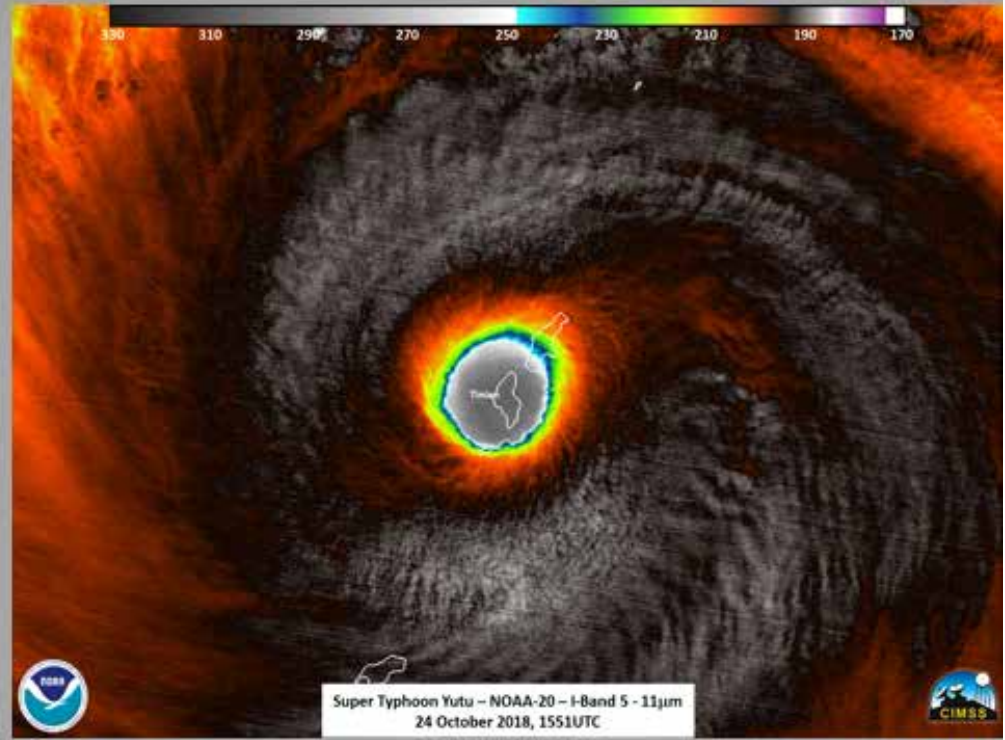
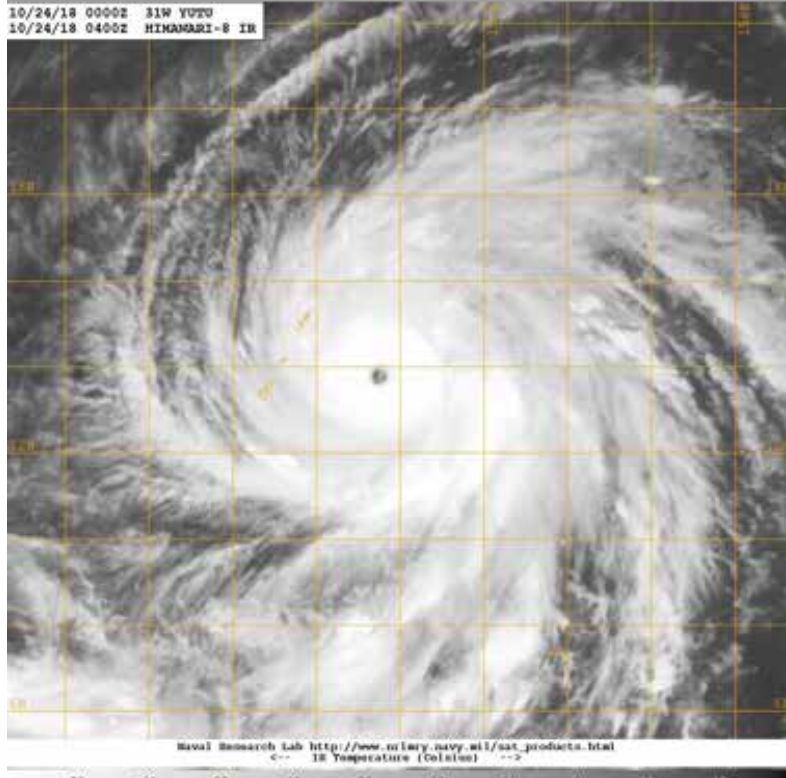


- **Totally, 20 Flood Watches and 4 Flood Warnings issued**
- **Typhoon Rumbia, Soulik and followed the torrential rainfall, (8.27-8.31) 6 Flood Watches and 2 flood Warnings issued on Han River basin**
 2 Flood Watches issued on Geum River basin



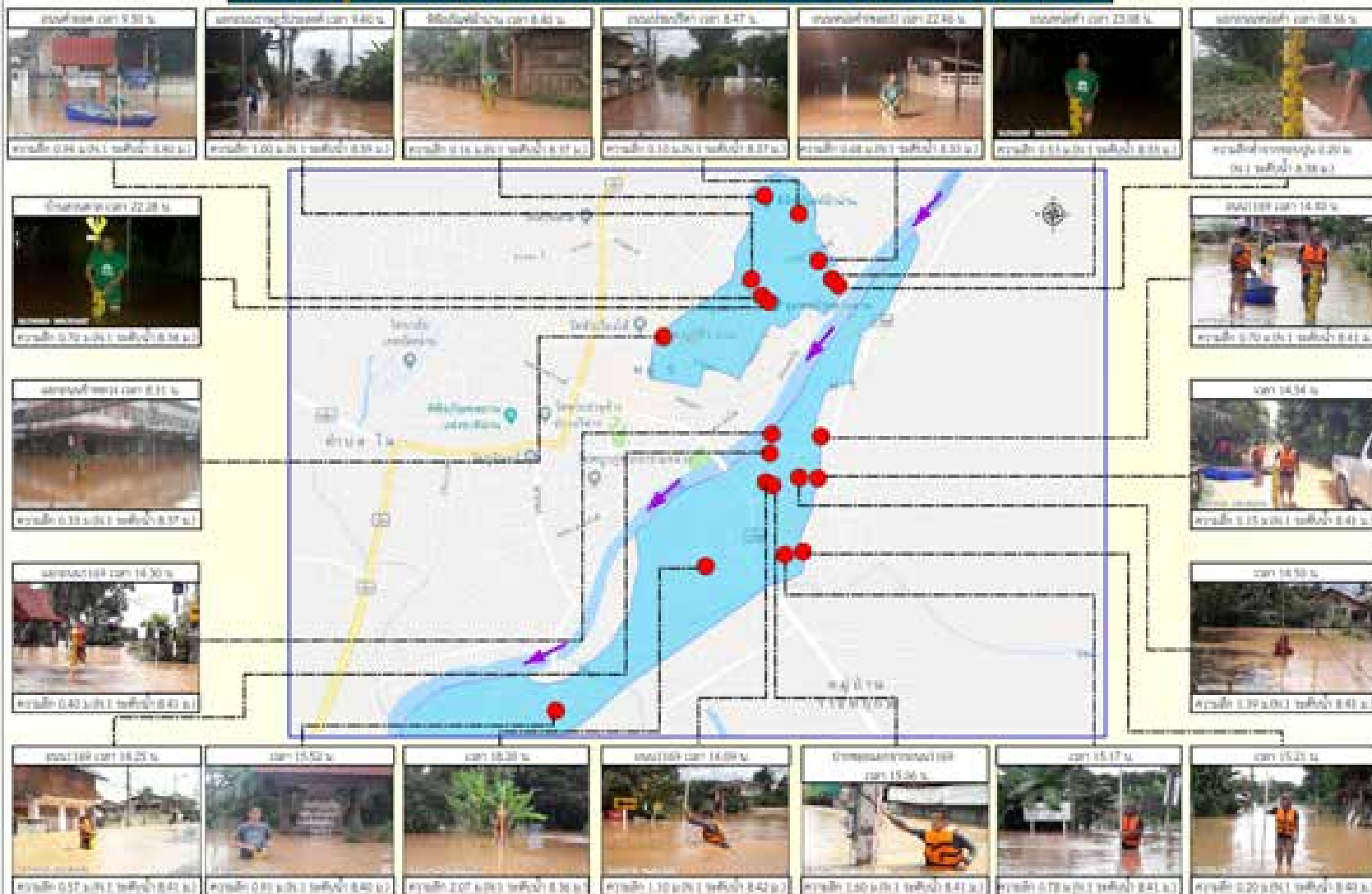


Super Typhoon Yutu



Flood Mark Stations in Nan City (18 Aug 2018)

แผนที่แสดงจุดตรวจระดับน้ำท่วม แผนที่น้ำท่วม ส่วนสถานีวัดระดับน้ำ: อำเภอเมือง จังหวัดน่าน เมื่อวันที่ 18 สิงหาคม 2561



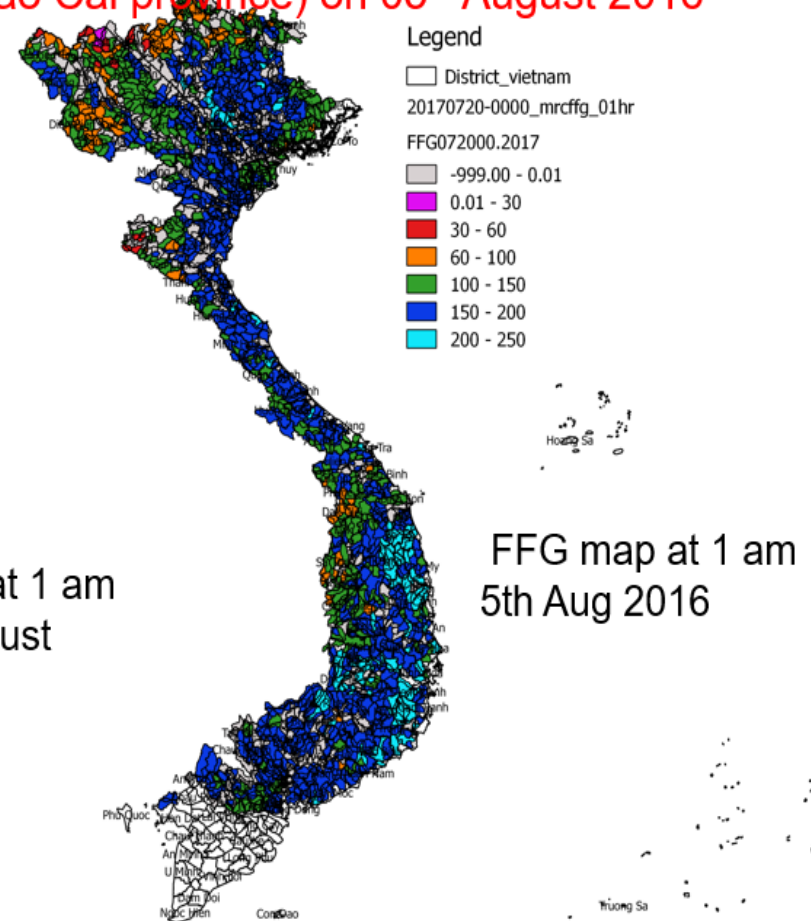
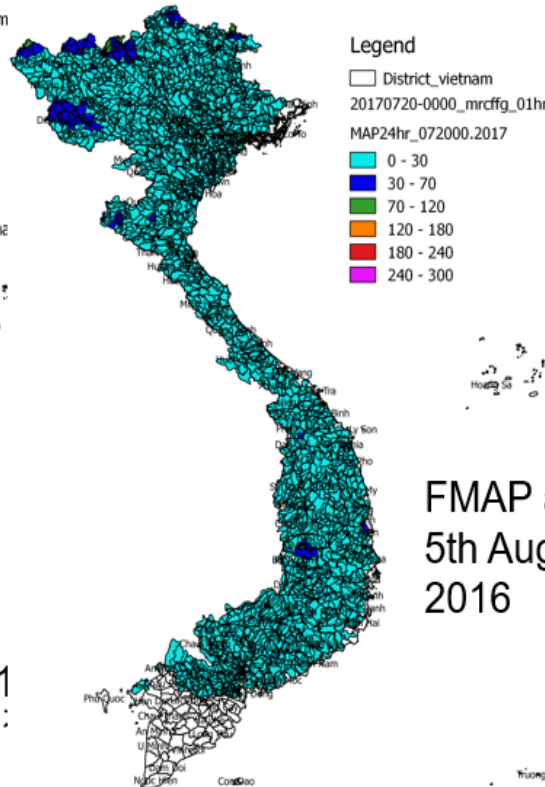
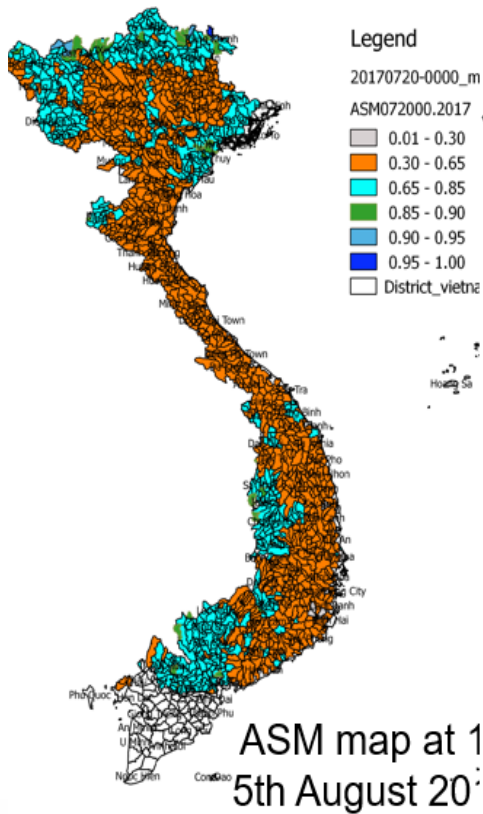
ศูนย์ปฏิบัติการและประสานงานป้องกันและบรรเทาสาธารณภัยจังหวัดน่าน





USING FLASH FLOOD GUIDANCE SYSTEM (FFGs) for early risk warning

Flash flood events in Bat Xat and Sa Pa districts (Lao Cai province) on 05th August 2016



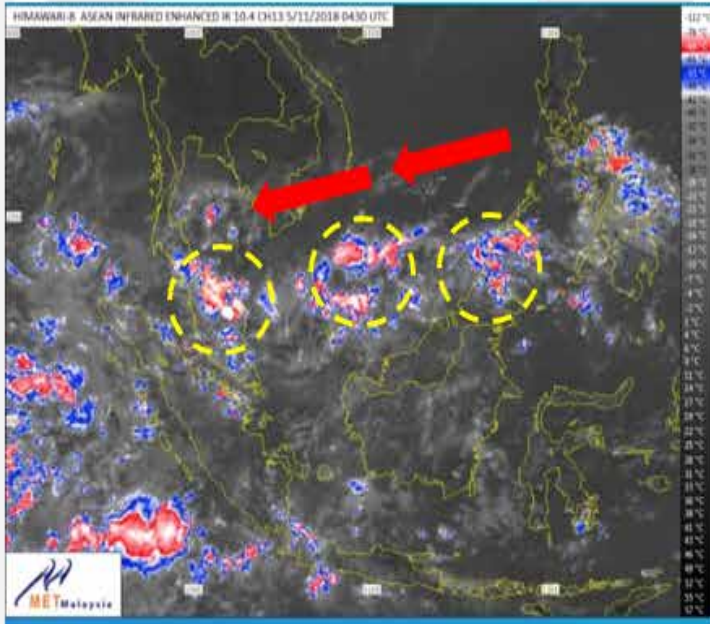
FLOOD FORECAST WARNING FOR 07/11/18

MetMalaysia



05 NOV 2018 13:00

Masa dikeluarkan:
ah hari: 5 November 2018



➤ Heavy rainfall warning (orange)

PRABN - DID



JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN AIR, TANAH DAN SUMBER ASLI

AMARAN BANJIR
LEMBANGAN SUNGAI TERENGGANU

Dikeluarkan pada 05 November 2018: 9.00 malam (Kemaskini Amaran Banjir No. Rujukan: JPS-PRABN-TRG-051118-1800)

Susunan Amaran Cuaca Buruk oleh Jabatan Meteorologi Malaysia bertakrif 05 November 2018 pada jam 1.00 petang, Jabatan Pengairan dan Saliran meramalkan banjir akan berlaku bermula 7 November 2018 mulai pada jam 1.00 pagi di lokasi-lokasi seperti berikut:

Negeri	Lembangan Sungai	Sungai	Daerah	Lokasi Dijangka Banjir
Terengganu	Sungai Terengganu	Sg Telemong	Hulu Terengganu	Kg. Basung, Kg. Teris, Kg. Tok Lawit, Kg. Tengkuawang, Kg. Kuala Ping, Kg. Kepar
Terengganu	Sungai Terengganu	Sg Nerus	Setiu	Kg. Langkap, Kg. Merbau Menyusut dan kawasan sekitarnya.

Banjir dramalkan akan berlaku bermula 7 November 2018 mulai pada jam 11.00 pagi di lokasi-lokasi seperti berikut:

Negeri	Lembangan Sungai	Sungai	Daerah	Lokasi Dijangka Banjir
Terengganu	Sungai Terengganu	Sg Telemong	Hulu Terengganu	Kg. Matang, Kg. Nibong, Kg. Paloh Nyior, Kg. Bukit Tadok

Semua penduduk terutamanya di kawasan yang dijangka banjir diminta berwaspada dan sentiasa berhubung dengan Pusat Kawalan Operasi: Banjir yang berhampiran. Maklumat dan amaran akan disalurkan kepada agensi pengurusan bencana, media dan orang awam melalui laman web publicinfobanjir.water.gov.my, facebook: [PublicInfoBanjir](https://www.facebook.com/PublicInfoBanjir) dan twitter @JPS_InfoBanjir.

Dikeluarkan oleh:
Pusat Ramalan Dan Amaran Banjir Negara (PRABN)
Jabatan Pengairan dan Saliran, Malaysia

No. Rujukan: JPS-PRABN-TRG-051118-2100

05 NOV 2018 21:00

2 DAYS EARLY WARNING

➤ 6 location will flood on 07/11/18 01:00

➤ 4 location will flood on 07/11/18 11:00

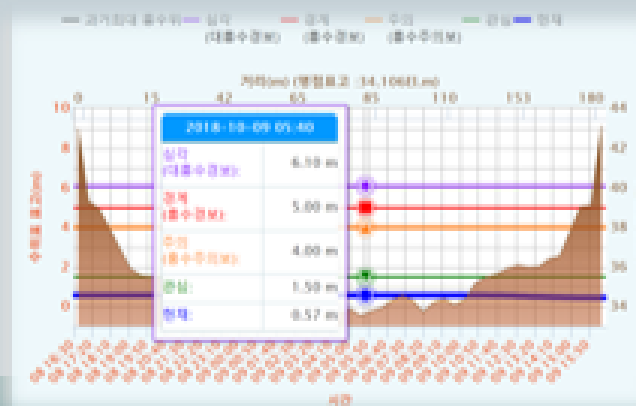
Improvement of Works to Expand Flood Forecasting Impacts



❖ Considerations of Flood forecasting and information service expansion

- The number of a flood forecast(watch & warning) will be **increased** from 55 to 70 points
- **Instead of forecast, the flood information** based on the observation data will cover the tributary basins without enough lead time
- **Classification of water level information** into four levels, such as “low”, “medium”, “high”, and “severe” **secure the safety** more than just two standards watch and warning
- **Making a manual for flood response in cooperation with related organizations** be necessary
- The projects are underway to expand the lead time for forecasting and to develop technology for prediction of

flash flood and urban lowland flooding.



2. Review the 7th working meeting of WGH;

Date: 9th to 12th October, 2018 in Tokyo, Japan

Host: Ministry of Land Infrastructure, Transport and Tourism (MLIT)

- 28 participants in total from 8 Members, (China, Japan, Laos, Malaysia, Philippines, the Republic of Korea, Thailand, USA and Vietnam) the hydrologist of TCS. Three experts (Mr. Eito, Ms. HASEGAWA and Ms. IGARASHI) from JMA participated as observer.
- The Meeting was co-chaired by WGH chairperson Mr. Tokunaga YOSHIO, vice chairperson Dr. Hyo-Seob CHO, and the hydrologist of TCS.
- The meeting included one-day seminar funded by China on Decision Supporting to SOP for Coastal Multi-hazards Early Warning and Reduction.



2. Review the 7th working meeting of WGH;

Agenda;

reviewed the implementation progresses of WGH Annual Operating Plan (AOPs) in 2018;

three technical reports

- 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 HRFCCO.



2. Review the 7th working meeting of WGH;

Agenda;

- ③ updated proposal of co-chairs system
- ④ Site Visiting; Sakai Town
- ⑤ One day Seminar by China

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



2. Review the 7th working meeting of WGH;

Agenda;

⑥ Other;

- The RO Korea expressed its willingness to host WGH 8th Working Meeting early October 2019. The participants expressed their sincere appreciation to Republic of Korea for the generous offer.



3. Review the implementation status of WGH AOP 2018;

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, Japan


Overall Goal

minimize losses caused by flash flood and achieve sustainable development

Each Country



- strengthen legal frameworks
- implement policies and systems to support preventive investment and other effective measures
- additional structural and non-structural measures



close collaboration among

- organizations specialized in hydraulics and hydrology
- agencies / ministries of national / local governments

Among T/C members

- ← Experience
- ← Lessons
- Good Practices
- Measures

2018

- Holding 7th WGH Meeting in Tokyo
- 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.

2019

- Survey, Holding the workshop with TC member in February in the Philippines
- Making Report



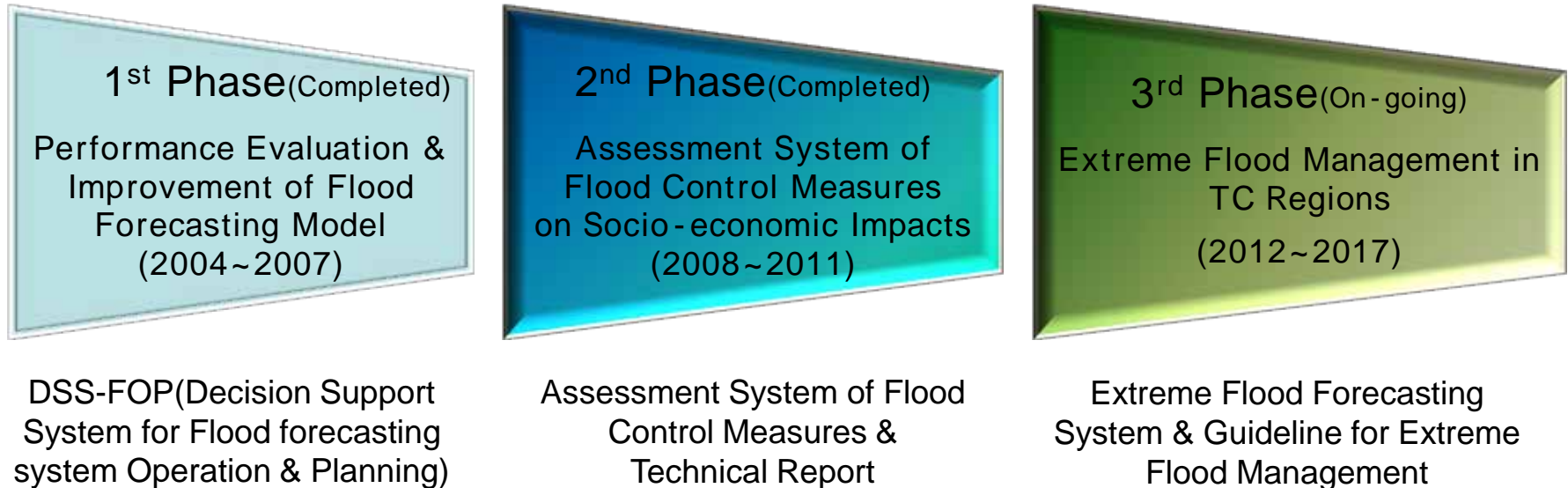
Good practices against flood in TC Countries : Strong / remarkable point, : Major issues)

Measures	Phase	Program	Cambodia	China	Japan	Lao PDR	Malaysia	Philippines	South Korea	Singapore	Thailand	Vietnam	America	
Law and regulations			Law on Disaster Management (2015)	Water Law (2002)	Amendment of River Act (1997)	No specific law on water-related hazards and disasters	No specific law on water-related disasters but the National Water Resources Act is in the construction process	Philippine Disaster Risk Reduction and Management Act (2010 RA-1121)	River Act	No specific law on water-related hazards and disasters	The National Disaster Prevention and Mitigation Act, BE 2551 (2007)	Law on Natural Disaster Prevention and Control (2014)	Flood Control Act, etc.	
Organizational Structure			National Committee for Disaster Management (NCM) + Red Cross	The State Flood Control and Drought Relief Headquarters (SFCDRH)	Disaster Management Bureau, MLT	National Disaster Management Committee, National Disaster Management Office (NDMC)	National Disaster Management Agency	National Disaster Risk Reduction and Management Council (NDRMC), The Office of Civil Defense (OCD)	Ministry of Land, Infrastructure and Transport (MOLIT)	Public Utilities Board (PUB), Singapore Civil Defense Force (SCDF)	Natural Disaster Prevention and Mitigation Committee (NDPM), Department of Disaster Prevention and Mitigation (DPM)	Steering committee for natural disaster prevention + control (national committee for searching and rescue)	Federal Emergency Management Agency / US Army Corps of Engineers (contracted administrative organization)	
Plan	Prevention / Mitigation		Strategic National Action Plan for Disaster Risk Reduction 2008-2013	National 13th Five Year Plan for Comprehensive Disaster Prevention and Reduction (2016-2020)		The Plan of National Disaster Management for the period 2011-2020	11th Malaysia Development Plan (2016-2020)	National Disaster Risk Reduction and Management Plan 2011-2016, National Calamities and Disaster Preparedness Plan, Medium Term Philippine Development Plan (MTPDP, 2004-2015)	3rd national safety management basic plan (2015-2019), The Basic River Planning	Not mentioned in the documents	Strategic National Action Plan for Disaster Risk Reduction 2010-2019 (SNAP), National Disaster Prevention and Mitigation Plan 2010-2014 (NDPMIP) and so on	Implementation plan for National Strategy for natural disaster prevention, response and mitigation	The Mississippi River: Formulating of flood control plan with a consistent and comprehensive perspective, such as MRAT project	
	Response		National Policy on Emergency Management (2011)	The strategy on the action of disaster emergency response system		Not mentioned in the documents	Not mentioned in the documents	'National Disaster Response Plan' is drafted by province, Emergency Response Plans were prepared in local communities (as of 2011)		Operations Civil Emergency (Ops CE) Plan	National Civil Defense Plan B.E. 2548 (2005)	and so on	Not mentioned in the documents	
Budget	Prevention / Mitigation		Disaster risk reduction resources are mainly borne by private agencies	Budget for flood control is 193.03 Billion Yuan for the period of flood control projects (as of 2015)	Budget for flood control is 609.8 Billion Yuan	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	RMB3 million for flood mitigation works (as of 2015). RMB 5 billion for flood management from 2016-2020	Budget (for flood control) GDP = approx. 0.2% (as of 2011). The total 173211 tenanted rural Calamity Fund (FC) Disaster Risk Reduction and Management (DRM) available under the Disaster mitigation and prevention activities (95% of the fund is allocated for 'Quick Response Fund' (Quick by Fund)	Budget (for flood control) GDP = approx. 0.2% (1999-2006)	Over the last 30 years, Singapore has invested some \$2 billion in building and upgrading Singapore's drainage infrastructure	Budget allocation and use of fund is decentralized to local administration infrastructure	CDMFC budget is used for flood relief in 19 out of 63 provinces. CDMFC was allocated 200 Billion VND in 2011. (MORRE) was allocated budget for meteorological hydrological stations, flood and storm insurance fund (100)	Budget for flood control is 4.939 Billion USD (as of 2011)	
	Response		The Government equate allocation for disaster management is utilized for emergency relief and response operation. Disaster risk reduction resources are mainly borne by private agencies	Budget (for flood control) GDP = approx. 0.2% (as of 2009)	Budget (for flood control) GDP = less than 0.2% (as of 2011)	Annual allocation of emergency fund (national budget) was around 160 billion Yuan for 2009-2010 and 100 billion Yuan for 2010-2011. MPWJ could arrange US\$6.8 million for the repair of roads and bridges.	The Government equate allocation for disaster management is utilized for emergency relief and response operation. Disaster risk reduction resources are mainly borne by private agencies	RMB50 million as initial allocation to repair and reconstruct basic infrastructure (reconstruction of roads, bridges, etc.) RMB50 million rehabilitation works and reduce program, RMB50 million for flood relief loan Guarantee Scheme	National budget for flood control. Rising trend from 2.7 to 50.8 Billion Won (1990-2011, November 2016)	The Budget size for SCDF (Singapore Civil Defense Force) on national level is about S\$200 million	Victim compensation budget and recovery budget for flood affected provinces	The budget for emergency response is set aside from 3-5% of national and provincial budget by the State Budget Law	budget/GDP = 0.2% to 0.5% (as of 2011)	
Prevention / Mitigation	Land-use regulation		Forest preservation by the designation of protection area	Detention basin in the Hai River basin, Soil and Water Conservation	Not mentioned in the documents	Land-use zoning, zoning of development (soil buffer, development point depending on the environment plan, MPAI)	Guideline to how to maintain disaster risk management in the 8th 5-year national economic development plan (2016-2020)	Comprehensive Land Use Plan. Land use control in the dangerous area (soils and slope) on the flood affected areas	Various regulations on urban planning	Not mentioned in the documents	Land-use regulation	Program for squatter relocation, Fostering program of urban housing	Floodplain management including stormwater drainage, warning system, land use plan, building-code and so on	
	Risk assessment / Hazard map		Not mentioned in the documents	Maintenance of flood prevention system, Flood risk mapping	Flood risk analysis associated with different phenomena	Not mentioned in the documents	Not mentioned in the documents	Natural disaster data & information management system (NDS) using remote sensing (GIS) and flood hazard maps	Development of flood hazard map by the several organizations (Inadequate for sharing of information)	ICT-based smart disaster management	Flood risk map is under development (as of 2012), flood area is published on the website	Not mentioned in the documents	Hazard map of the Mekong River, Flood hazard map in 4 states	Not mentioned in the documents
Awareness / Training			The budget allocated for disaster education for the cost of training	Not mentioned in the documents	Not mentioned in the documents	Several education for disaster prevention, awareness programs and campaign are implemented	Continues implementation of disaster education and so on	Integration of disaster prevention education, training, awareness for enhancement of disaster prevention	Not mentioned in the documents	Distribution of the Civil Protection emergency handbook, variety of program, education for community emergency preparedness, etc.	Promotion of disaster prevention education in school in national education plan (2007-2011) (lack of emergency preparedness)	National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020 (2007 - 2020)	6,000km of Embankment, urban stormwater drainage, floodplain management plan	Flood control facility plan, floodplain management policy
	River improvement		Canalage (irrigation channel) functions as drainage channel to drain water, receiving flood waves and so on	Embankments and Water Gates & etc. Detention basin in the Hai River basin	River improvement plan incorporating nature-based climate change	River bank erosion countermeasure and flood protection (dike maintenance)	River bank erosion countermeasure and flood protection (dike maintenance)	Law on dams, retention ponds, diversion channels, Stormwater Management and Rural Tunnel (SMART Tunnel) project	Capa VII, The Four Major Rivers Restoration Project including flood control, dams, etc.	Capa VII, The Four Major Rivers Restoration Project including flood control, dams, etc.	humps and flood barriers to prevent their basement levels from floodwaters	Not mentioned in the documents	Retaining basins, drainage treatment, embankment and on-ground dam, canal, multi-purpose dam, etc.	Not mentioned in the documents
Monitoring			10 meteorological stations along the Mekong, Tonle Sap and Bassac rivers	Meteorological flood disaster prevention system, China Integrated Meteorological Information Service System (CIMISS) and Forecasting and Early Warning (Warning messages of flood in its mountainous areas, SMS, text message, Chat alerts)	Water-Related Disaster Forecast Centers	Warning center or flood forecast system, National Early Warning Center will be completed in 2018, 3-year prior flood forecasting by the Mekong Committee	Hydrological stations by DID and meteorological stations by MMD (purchase plan of 16, 14-stations total). Forecast accuracy of the first flood forecasting and warning system (FFWS) in the Klang Valley basin (as of March 2012) is 84.8%	National Disaster Risk Reduction and Management Council (NDRMC), National Calamities and Disaster Preparedness Plan, Medium Term Philippine Development Plan (MTPDP, 2004-2015)	Urban Storm Water Management Practice (UMWP)	National Disaster Risk Reduction and Management Council (NDRMC), National Calamities and Disaster Preparedness Plan, Medium Term Philippine Development Plan (MTPDP, 2004-2015)	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Disaster Management Plan		Disaster Preparedness Plan	Flood management plans for the cities, The River Basin Flood Control Plans	Not mentioned in the documents	The Plan of National / Provincial Disaster Management, Plan of Action for DRR and Management of Disaster Database for the period of 2000-2005	Environmental Impact Assessment for new land development projects	The Ministry of Social and Welfare has installed and controlled relief / evacuation centers and stockpile bases	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Stockpiling			Emergency relief out of National Roads, and there are a small allocation of this fund and cash to NCM operations	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Emergency Operation Center		Committee for Disaster Management	SFCDRCS, Emergency response plans and systems for flood control	Technical Emergency Control Force	Emergency Task Force	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Flood fighting (voluntary)			Community Based Flood Mitigation and Preparedness (CBFMP) project and Red Cross Volunteers (RCVA)	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Timeline		Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Standard Operation Procedure			Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	First aid		Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Shelter & Evacuation			There is NO PLAN for evacuation and the warning is not raised	How to build the shelter who has been experienced the flood and evacuation warning in the detention basin	Not mentioned in the documents	No system for issuing of evacuation order. NCM decides as each time	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Rescue		NCM establishes the command system for rescue operation	Establishment of the construction of emergency rescue teams	Technical Emergency Control Force	Special Malaysia Disaster Assistance And Rescue Team (SMART)	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Initial damage assessment			National damage & needs assessments system are developed by NCM	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Damage assessment		Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Clean-up			Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Recovery planning		NCM shall formulate an emergency operational plan in cooperation with Cambodia Red Cross	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Reconstruction / Build Back Better			Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Restoration of system & facility		Not mentioned in the documents	Establishment of emergency water-source construction	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
Social compensation			Not mentioned in the documents	Organization, supervision and implementation of compensation	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	Not mentioned in the documents	
	Issues		OMI is not implemented properly due to limitation of budget. Lack of proper risk map, public awareness and education to encourage evacuation activity	Complicated-subs conditions of detention basin due to urbanization and evacuation of residents who have no insurance experience	Not mentioned in the documents	No legal system and insufficient budget for flood control. Warning standard for evacuation is not set yet.	No specific law on water-related disasters	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	Insufficient national budget for disaster prevention including the implementation of the National Strategy Plan (stockpile of relief commodities and maintenance of facilities and so on).	

Ex) Relocation of slum dwellers along canals in Ho Chi Minh City, Vietnam



AOPs led by Republic of Korea

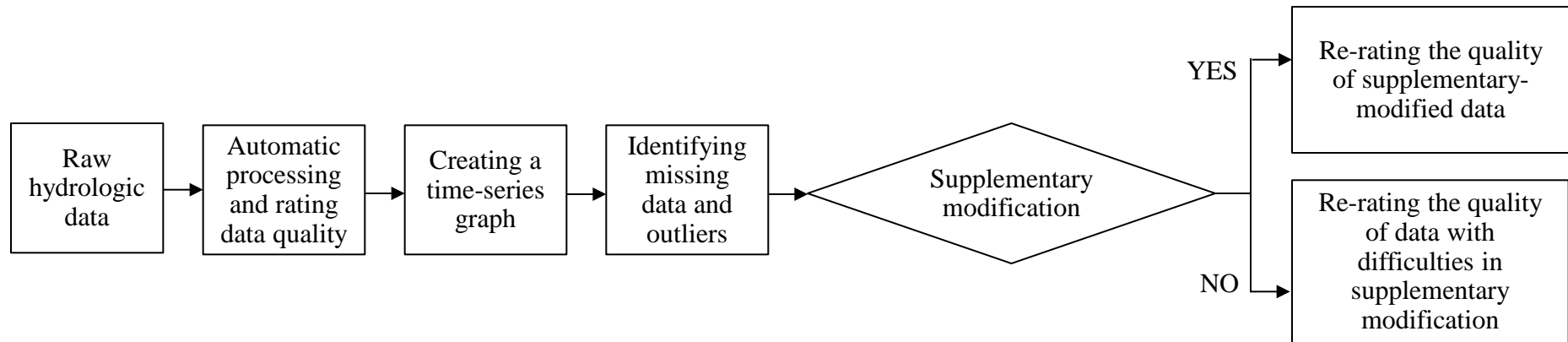


- Ø Continuity and sustainability of previous AOPs
- Ø Maximizing the output & Results of Previous AOPs
- Ø Consideration of the most necessary and practical aspects in TC members

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

- The project will be driven by HRFKO of Korea with support of KICT and 5 years from 2018 to 2022, with objects of:
 - enhancement of TC Member's capacity for managing & monitoring of hydrological data (Rainfall, Water Level, Discharge);
 - reducing the uncertainty of input data for flood forecasting;
 - suggesting the procedure of producing hydrological data; and
 - establishment of the hydrological data quality control system linkage to EFFS
- The basic methodology of data processing and quality control to be applied in the project can be briefed as:
 - Rainfall : arithmetic mean, RDS weighted average, Kriging method, etc.
 - Water Level : arithmetic mean, relationship with upper-down stream station, Neural Network, etc.
 - Discharge : calculation of uncertainty in measuring the discharge, assessment of stage-discharge relationship equation, etc.

Hydrological Data Quality Control System



<Systemic framework of hydrological data quality management >

- ü Automatic quality control on hydrological data automatically collected from rainfall and water level stations
- ü Statistical data analysis and quality ratings
- ü Annual report on national hydrological survey

Hydrological Data Quality Control System

가평(강) 관측소 우량자료

일시	1M 자료	보정값	우량	누가	변화	품질등급	비고
2013-07-11 00:00	00077	77	0.00	0.00		0100	
2013-07-11 03:00	00077	77	0.00	0.00		0100	
2013-07-11 06:00	00077	77	0.00	0.00		0100	
2013-07-11 09:00	00077	77	0.00	0.00		0100	
2013-07-11 12:00	00077	77	0.00	0.00		0100	
2013-07-11 15:00	00077	77	0.00	0.00		0100	
2013-07-11 18:00	00077	77	0.00	0.00		0100	
2013-07-11 21:00	00077	77	0.00	0.00		0100	
2013-07-12 00:00	00077	77	0.00	0.00		0100	

가평(강) 관측소 우량자료 그래프: 가평(강) 수위(수평선), 우량(수직선). Y-axis: 수위(m) 0~10, 우량(mm) 0~12. X-axis: 07-11 00:00, 07-11 18:00, 07-12 02:00.

가평(강) 관측소 우량자료

관측소 정보
 관측기종: 유출계량계 (0)
 계보유형: 관강 (01)
 관측소: 가평(강) (10004010)
 주소: 강원도 울진군 두포면
 데이터 주소: 하안지역 가평유역

Method를 이용한 수량
 ACS Method 사용유무: 사용/유무
 품질수준: 자동/수동
 다른 관측소 간선험수: 사용/유무
 추가자료로 우량자료 사용: 사용/유무
 CC&M Method

부정자료 수정

- 부정자료 - 1M자료: 자동/수동
- 부정자료 - 실시간 부정자료: 자동/수동
- 부정자료 - 보정값 (X, S): 사용/유무
- 부정자료 - 0: 자동/수동

관측자료 수정

- 우량자료 - 보정값을 적용한 우량자료 삭제: 자동/수동
- 우량자료 - 실시간 부정자료: 자동/수동
- 우량자료 - 우량자료 (X, S): 사용/유무
- 우량자료 - 0: 자동/수동
- 우량자료 - 과잉에서 불리요자: 자동/수동

관리상태 수정

- 관리상태 - 수동보정: 자동/수동
- 관리상태 - 원상: 자동/수동

품질등급 및 참조사항 수정

- 품질등급 - 0100: 자동/수동
- 참조사항:
- 참조사항:

가간사항

- 수량자료 - 관측자료: 자동/수동
- 수량자료 - 평가: 자동/수동

수량자료 최종 자동



AOP 2

Application of Hydrological Data Quality Control System in TC Members, RO Korea

Ø Implementation Status of WGH AOP 2018

- | Analyze the status of hydrological data monitoring and management in TC members – **Yes**
- | Exchange & confirm the results of analysis - **Yes**
- | Survey the Hydrological Data Quality Control System in Republic of Korea – **Yes**

Ø Success Indicators of WGH AOP 2019

- | 1st Field survey results of status analysis for hydrological data quality control management in 5 countries (ROK, Thailand, Philippines, **Lao P.D.R, Malaysia**)
- | Design report for establishment hydrological data quality control system
- | Drafting Technical report (draft version) for hydrological quality control system

AOP 3

Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique, RO Korea

Ø Background

- Overcome the difficulties of flood forecasting in ungauged area and the limitation of deterministic flood forecasting
- Provide the various information of flood forecasting for the public people

Ø Objectives

- Enhance TC Member's capacity for flood forecasting using radar rainfall data & stochastic techniques
- Upgrade the LEVEL3 module of EFFS
- Suggest the guideline for operating Rainfall Radar
- Evaluate the uncertainty of flood forecasting
- **Suggest the procedure of stochastic flood forecasting**

Ø AOP Period

- 2018-2022 (5 years)

Ø Target Country

- **Lao P.D.R, Philippines, Republic of Korea, Thailand**

Rainfall(QPE) observed by rain radar



Rainfall(QPF) Forecasted using rain radar

구역	좌천	발전구역	QPF(mm)		
			1시간	3시간	6시간
0001	황지천	강원 태백시 홍지동	0.3	0.2	0.1
0002	황지천	강원 태백시 홍지동	0.2	0.1	0.0
0003	황지천	강원 태백시 홍지동	0.2	0.1	0.0
0004	황지천	강원 태백시 홍지동	0.3	0.2	0.1
0005	황지천	강원 태백시 홍지동	0.2	0.1	0.1
0006	철암천	강원 태백시 홍지동	0.2	0.1	0.1
0007	황지천	강원 태백시 홍지동	0.2	0.1	0.0
0008	황지천	강원 태백시 홍지동	0.1	0.1	0.1
0009	황지천	강원 태백시 홍지동	0.1	0.0	0.1
0010	황지천	강원 태백시 홍지동	0.1	0.0	0.1
0011	철암천	강원 태백시 철암동	0.1	0.1	0.1
0012	철암천	강원 태백시 철암동	0.1	0.1	0.1
0013	소도천	강원 태백시 금천동	0.1	0.0	0.1
0014	소도천	강원 태백시 홍지동	0.1	0.1	0.1
0015	소도천	강원 태백시 홍지동	0.1	0.1	0.1
0016	철암천	강원 태백시 철암동	0.1	0.1	0.1
0017	낙동강	강원 태백시 강성동	0.2	0.1	0.1
0018	황지천	강원 태백시 강성동	0.1	0.1	0.1
0019	황지천	강원 태백시 강성동	0.1	0.1	0.1
0020	소도천	강원 태백시 소도동	0.1	0.0	0.1

Flash Flood Forecasting

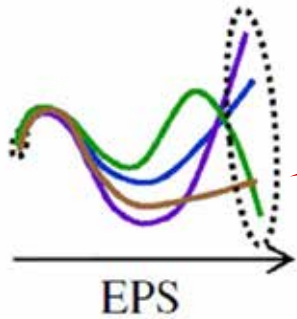


행정구역별 돌발홍수 위험단계 상세 정보

행정구역	돌발홍수 위기경보 단계				하천
	관심	주의	경계	심각	
경남 밀양시 상동면 옥산리			경계		청도천
경남 산청군 금서면 매촌리				심각	특리천
경남 산청군 금서면 매촌리				심각	남강
경남 산청군 금서면 매촌리	관심				금서천
경남 산청군 금서면 방곡리	관심				임천
경남 산청군 금서면 수철리	관심				금서천
경남 산청군 금서면 신아리	관심				임천
경남 산청군 금서면 신아리				심각	특리천
경남 산청군 금서면 오봉리	관심				임천
경남 산청군 금서면 오봉리		주의			덕천강
경남 산청군 금서면 자혜리	관심				임천
경남 산청군 금서면 자혜리	관심				금서천
경남 산청군 금서면 주상리	관심				임천
경남 산청군 금서면 지막리	관심				금서천
경남 산청군 금서면 지막리		주의			덕천강
경남 산청군 금서면 지막리	관심				덕천강
경남 산청군 금서면 특리			경계		대포천

<Flash flood forecasting information for local governments>

Stochastic Flood Forecasting

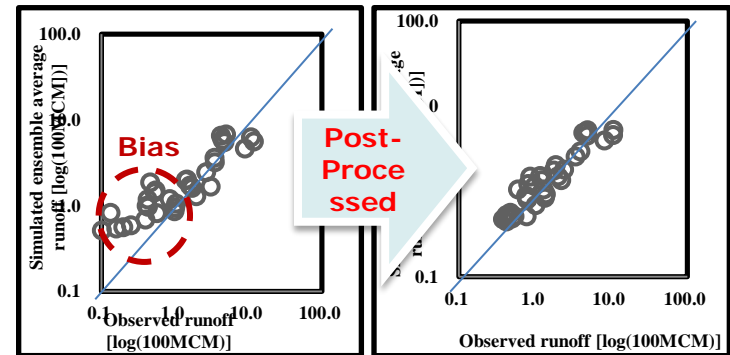


ü Uncertainty of EPS (Ensemble Prediction System) can exist

ü **Pre-processor** : remove the uncertainty

Rainfall Ensemble
(Ensemble Prediction System)

Rainfall-
Runoff
Model



ü **Post-processor** : remove the structural uncertainty of rainfall-runoff model and parameter uncertainty

Streamflow
scenarios



Warning



<Concept Diagram of Ensemble Model>

AOP 3

Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique, RO Korea

Ø Implementation Status of WGH AOP 2018

- | Analyze the status of operation and flood forecasting with radar rainfall data in TC members – Yes
- | Exchange & confirm the results of analysis - Yes
- | Survey the Radar Data application and operation rules in flood forecasting system in Republic of Korea – Yes

Ø Success Indicators of WGH AOP 2019

- | **1st Field survey** results of status analysis for flood forecasting using radar rainfall data in 4 countries (ROK, Thailand, Philippines, Lao P.D.R)
- | Design report for upgrading LEVEL 3 (EFFS) & establishment stochastic forecasting system

AOP4

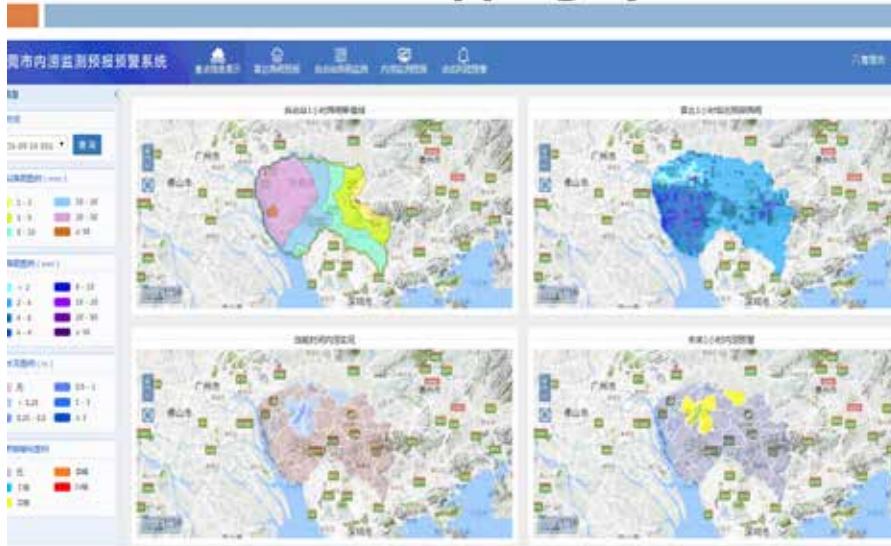
OSUFFIM (Operation System for Urban Flood Forecasting and Inundation Mapping) Phase-II: Extension of OSUFFIM Application in TC Members, China

- SYS University conducts OSUFFIM Phase-II as one of WGH AOPs from 2018 to 2020. The pilot cities are selected from TC Members.
- Implementation status of the AOP for **2018**:
 - the river basin in Hue city was selected as the pilot study in Viet Nam at TC 50th Session in Hanoi, Vietnam for OSUFFIM-II.
 - the model for Hat Yai was set up tentatively. September 15 to 19, 2018,
- In 2019, following activities will be conducted.
 - to host OSUFFIM workshop during TC session in 2019 (tentative);
 - to print the publication of technic report;
 - 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 .



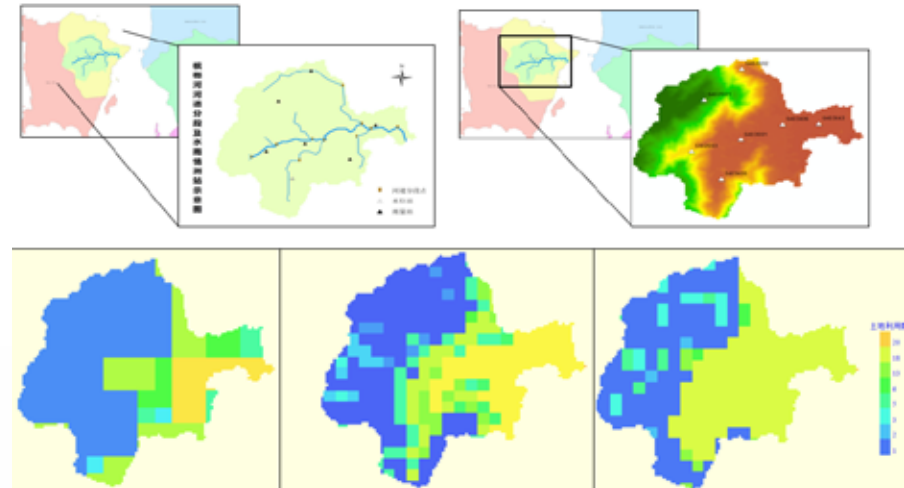
- OSUFFIM Activities Sites
- Pilot study in Dongguan City, China
- Pilot study in Hat Yai City, Thailand
- OSUFFIM II : pilot study in Malaysia
- OSUFFIM II : pilot study in Viet Nam

Urban Flood Forecasting and inundation mapping system



OSUFFIM II : pilot study in Malaysia

Penang River



AOP5

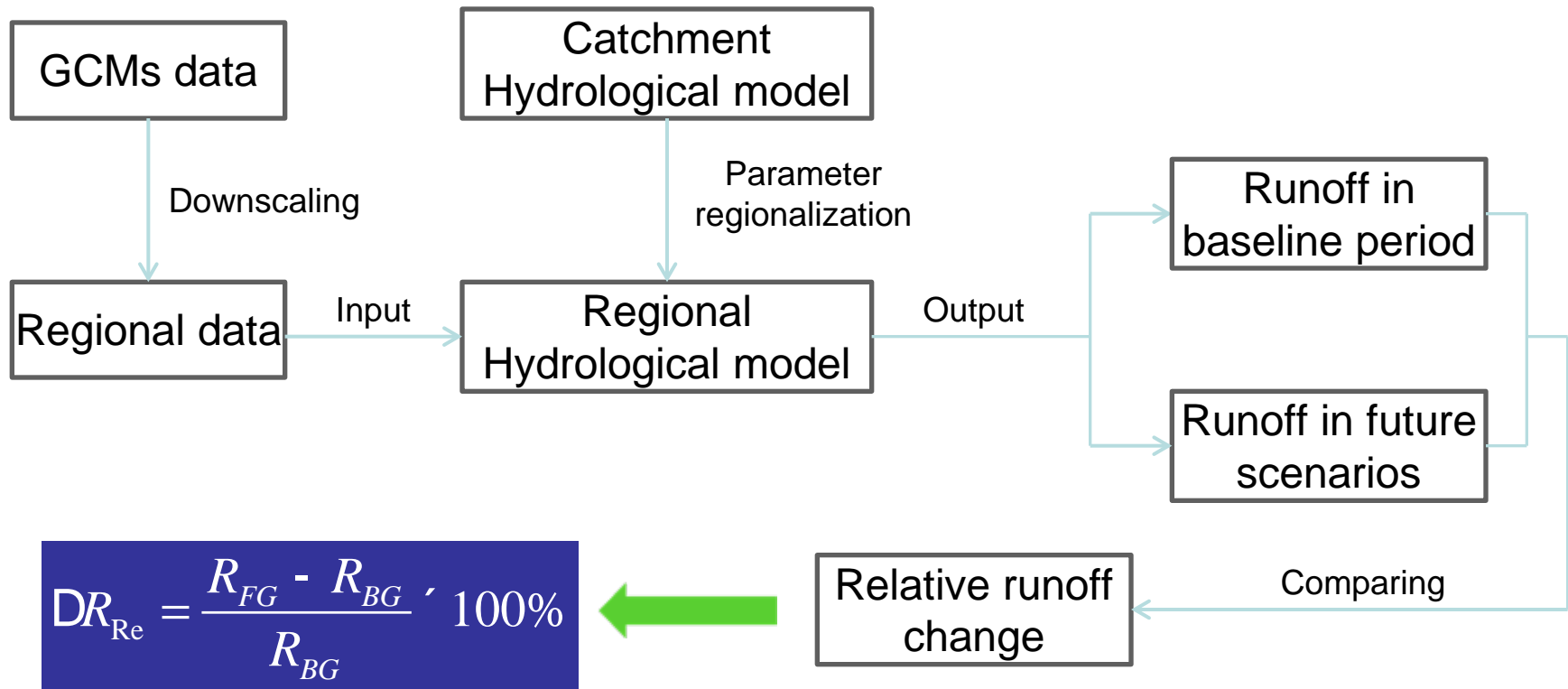
Impact Assessment of Climate Change on Water Resource Variability in TC Members, China

- The project will be drove from 2018 to 2020 by Water Information Center (WIC) of the Ministry of Water Resource (MWR) with support from Nanjing Hydraulic Research Institute (NHRI). The project was proposed with following object, target and output:
- **Objective: the proposal is to collect, collate, analyst, evaluate and develop the water resources modelling information for better decision management system** so that to improve the capacity building among TC Members on better understanding water modelling and water resources management.
- **Target: extension of the RCCC-WBM model by job training with TC expert on water resources modelling and decision-making process.**
- Output: providing the sustainable water resources information for water resources manager decision making process.



1. **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.**
2. **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.**
3. In **2019**, following activities will be conducted.
 - **To organize 3-day on-job training for selected Members (Malaysia and Laos) in January 2019;**
 - 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)

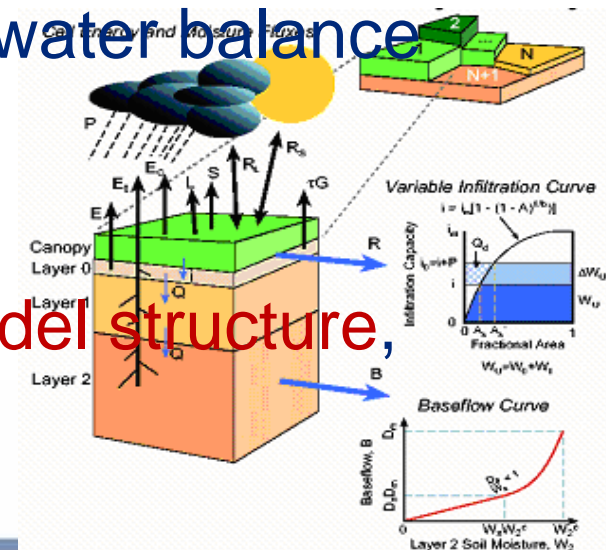
Methodology



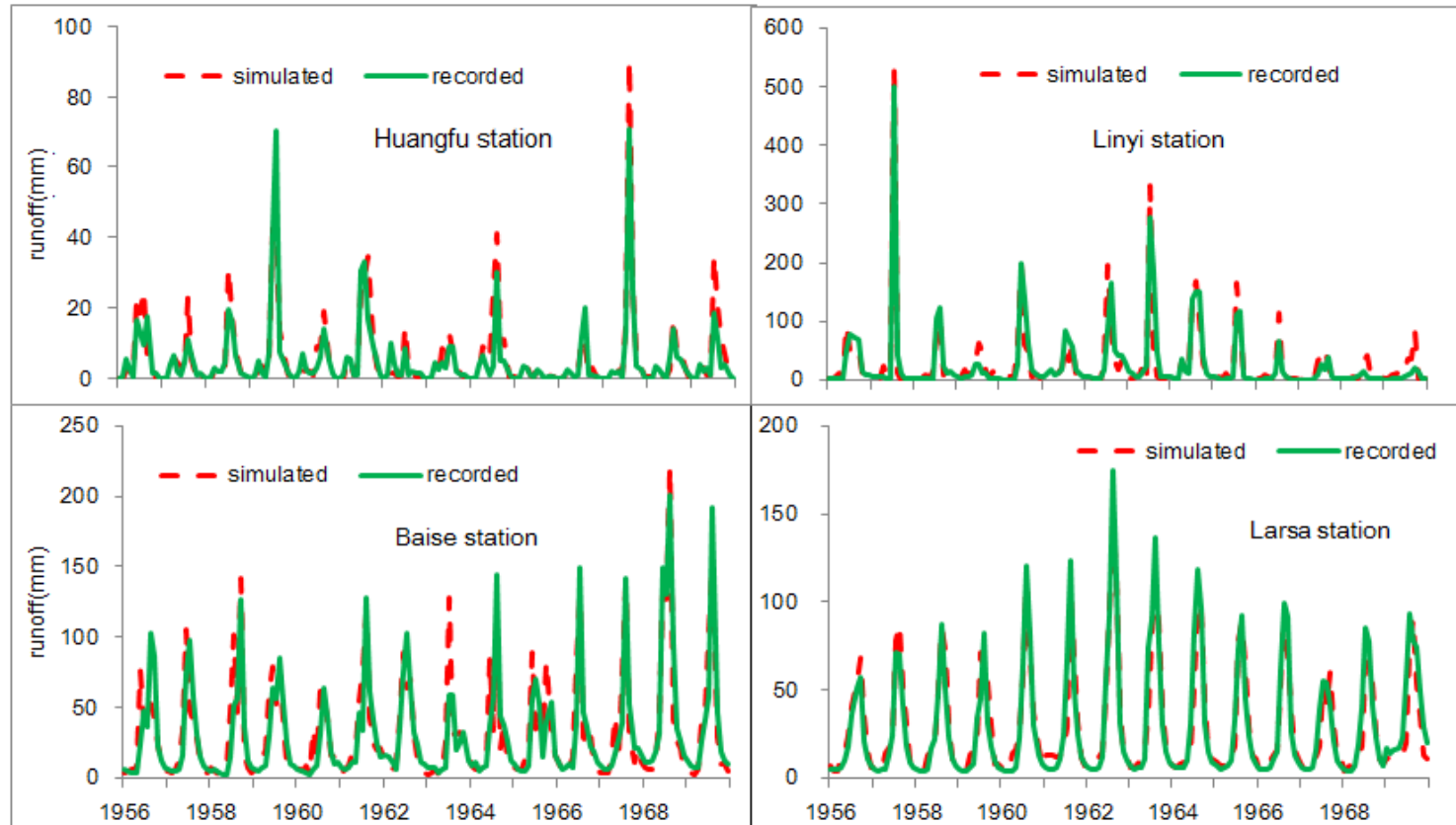
- R_{Re} : Relative runoff change in future scenarios compared to it in baseline period
- R_{FG} : Simulated average annual runoff using data in future scenarios from GCMs
- R_{BG} : Simulated average annual runoff using data in baseline period from GCMs

RCCC-WBM model

- Suitable hydrological models have been believed a powerful tool in water resources assessment.
- RCCC-WBM model was developed by Research Center for Climate Change (RCCC), which is a simplified lumped hydrological model based on water balance principle.
- It has the advantages of a **simpler model structure**, **fewer parameters** and **more flexibility**.



Application of RCCC-WBM



Monthly recorded and simulated discharges from 1956-1969 for 4 typical catchments

- **The simulation results are acceptable for all stations by the model, therefore it could be applied for assessing and simulating regional water resources.**

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



The summary of WGH AOPs in 2019 and beyond

Item	Projects	Driver	Duration
AOP 1	Flash Flood Risk Information for Local Resilience	Japan	2017~2019
AOP 2	Application of Hydrological Data Quality Control System in TC Members	Korea	2018-2022
AOP 3	Enhancement of Flood Forecasting Reliability with Radar Rainfall Data and Stochastic Technique	Korea	2018-2022
AOP 4	OSUFFIM Phase-II: Extension of OSUFFIM Application in TC Members	China	2018~2020
AOP 5	Impact Assessment of Climate Change on Water Resource Variability in TC Members	China	2018~2020
New AOP 6	Flood Risk Watch Project for Life-saving	Japan	2019~2022
New AOP 7	Platform on Water Resilience and Disaster under IFI	Japan	2019~2022



AOP 6 Flood Risk Watch Project for Life-saving, Japan

- ρ 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 land slides. **There were a number of disaster victims, escalated by delay in evacuation.**
- ρ Because modern river improvement by river facilities".
 - However, recent severe flood damages remind us that
 - “Large-scale floods can exceed river facilities’ capacity”.
- ρ Climate change is now acerbating flood magnitude and frequency. A whole society should prepare for future possible succeeded in reducing flood events in last 100 years, the society had dreamed that
 - “Any flood can be prevented flood disasters.
- ρ In this situation, the MLIT published a new policy vision of
 - **“Rebuilding Flood-conscious Societies”**.
- ρ While structural measures take long period of time, the MLIT put the highest priority in human lives and launched a new project for fail-proof evacuation]
 - **“No failure in evacuation”**.

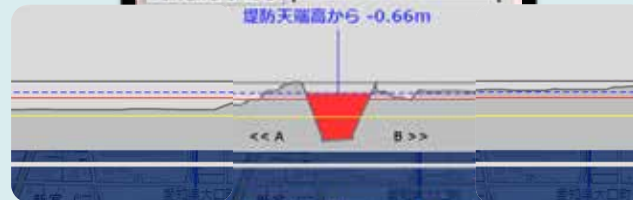
Most-advanced hydro-infomatic project

- Cut cost to install into as many flood-prone areas as possible
- Provide real-time information for **emergency operation**
- Develop flood prediction system in small/medium-scale rivers

Japan's case



<https://k.river.go.jp>



<https://www.river.go.jp/e/>



LLL water level gauges

✓ **Low cost**

- Measure river level only during flood
- Less than 10 thousand US\$ for initial cost

✓ **Long life**

More than 5 years operation without power supply

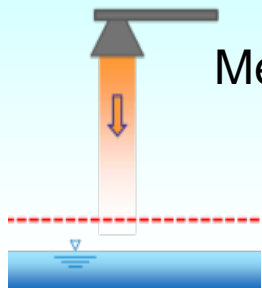
✓ **Localized**

Local river authorities are able to maintain it and use data

Power Saving by Mode Switching

once a day

<Power saving>

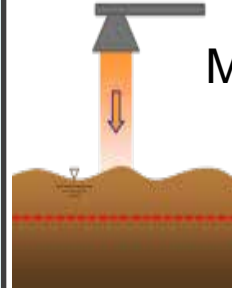


Measurement every 10 mins

Cloud

every 5 - 10 mins

<During flood>



Measurement every 5-10 mins

Data Transmission



Web Application

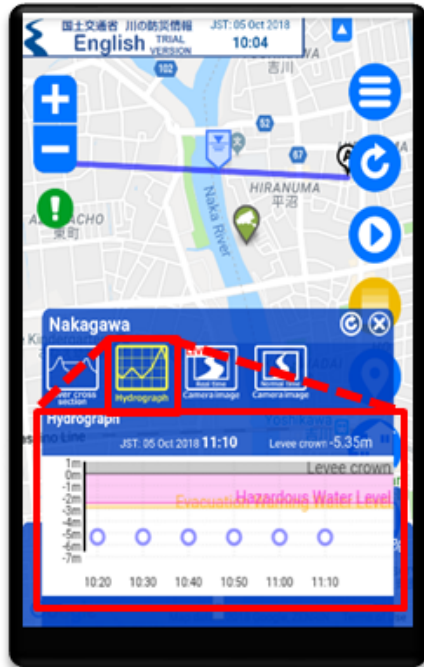
Real-time data required for user-oriented project

Real-time and wide-range rainfall data



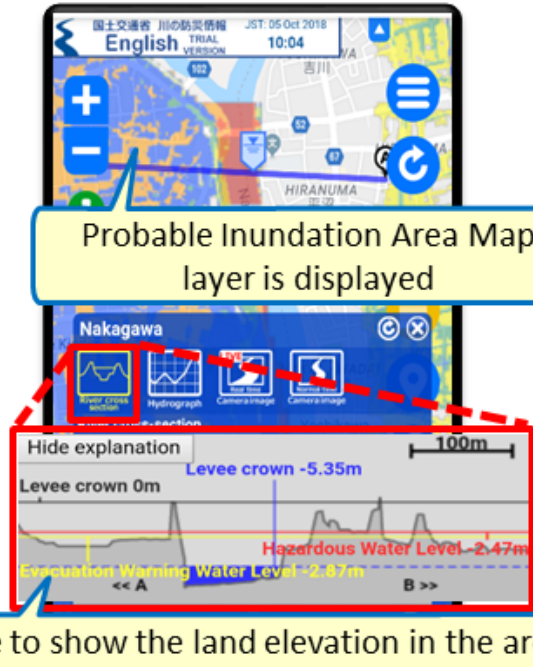
Current and past river levels, showing the trend of river level rise

(Image)



Lateral profile of the current river level, showing the risk stage of flooding

(Image)

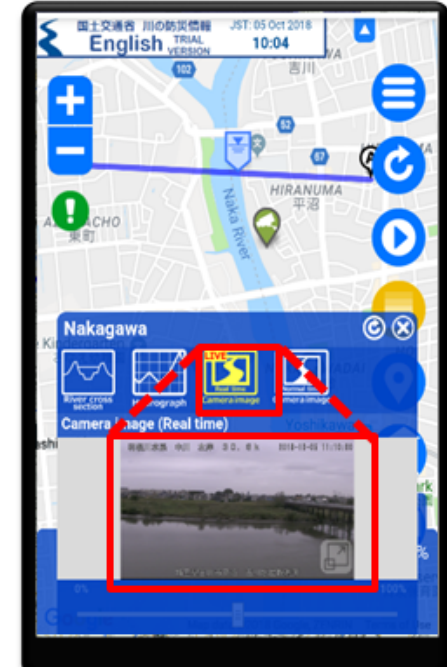


CCTV camera



Live image from CCTV camera, showing the condition of river and flood plain

(Image)

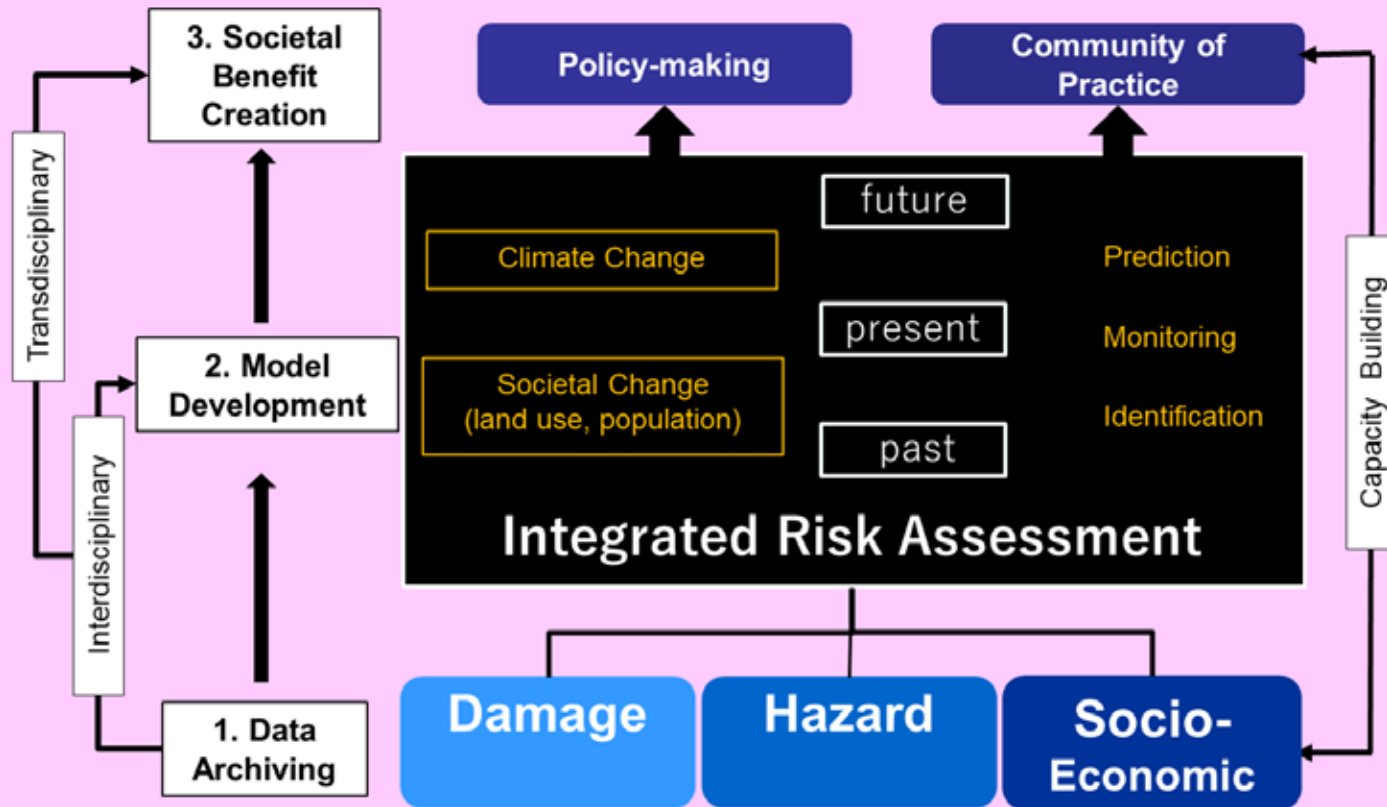


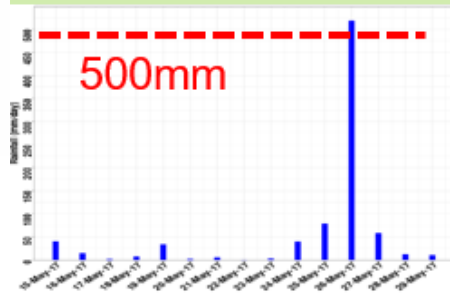
Real-time and on-site water level data

AOP7

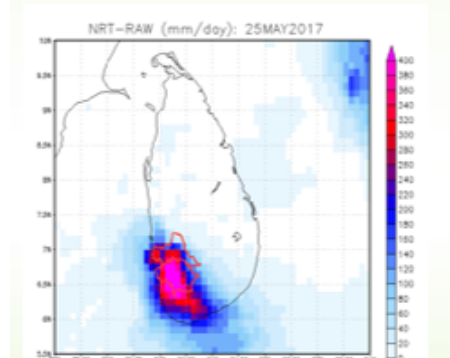
Platform on Water Resilience and Disaster under IFI (International Flood Initiatives), Japan

Platform on Water Resilience and Disasters

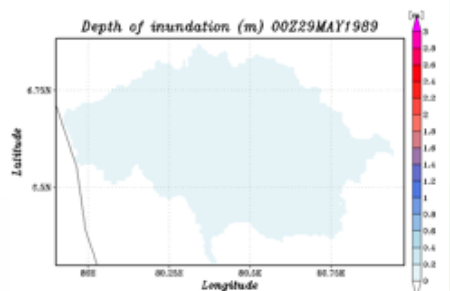




Real-time Rain Gauge Data

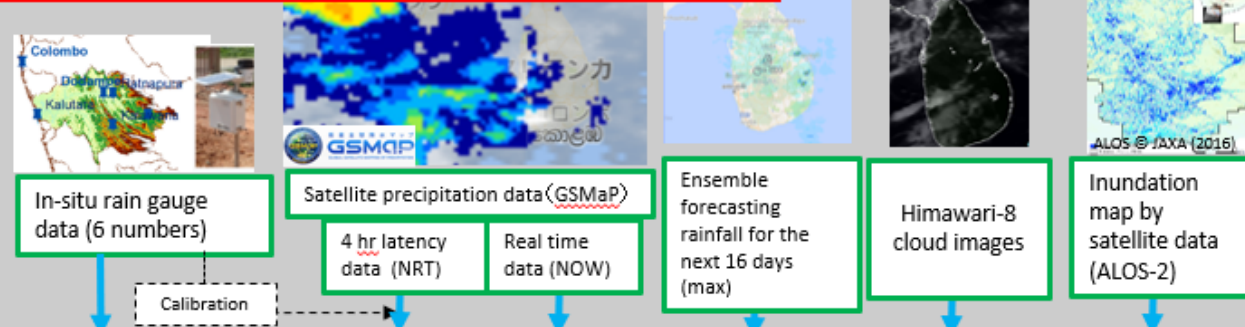


Bias-corrected Satellite Rainfall



Inundation

Implemented by EDITORIA and ICHARM on DIAS



Flood Forecasting for Sri Lanka

On-line Information provision on DIAS: In-situ rainfall, satellite rainfall, calibrated and forecast rainfall, inundation simulations

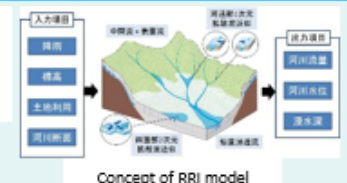
Flood Forecasting for Sri Lanka

Station	Station Name	Latitud	Long	2 Day	3 Day	5 Day
1	Colombo	6.92	79.86	0.00	0.00	0.00
2	Colombo	6.92	79.86	11.00	11.00	11.00
3	Colombo	6.92	79.86	22.00	22.00	22.00
4	Colombo	6.92	79.86	33.00	33.00	33.00
5	Colombo	6.92	79.86	44.00	44.00	44.00
6	Colombo	6.92	79.86	55.00	55.00	55.00
7	Colombo	6.92	79.86	66.00	66.00	66.00
8	Colombo	6.92	79.86	77.00	77.00	77.00
9	Colombo	6.92	79.86	88.00	88.00	88.00
10	Colombo	6.92	79.86	99.00	99.00	99.00
11	Colombo	6.92	79.86	110.00	110.00	110.00

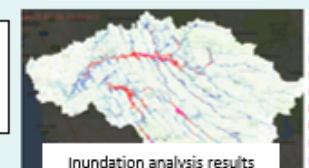
Inundation analysis by using RRI in DIAS

RRI model

Simulation and forecasting of river discharge, water level, inundation extent



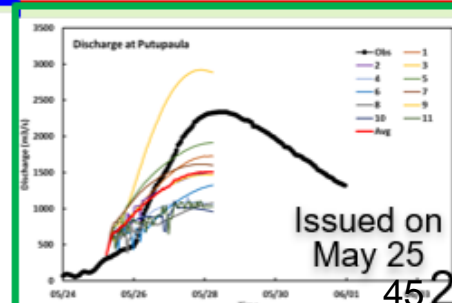
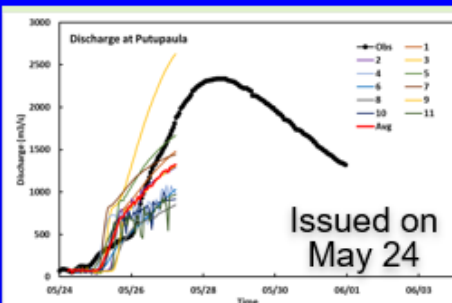
Concept of RRI model



Inundation analysis results

Ensemble Flood Prediction

72hr 11 ensembles every 24hr



45/28

4. Discuss the implementation plan of WGH AOP and budget request for 2019

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
6	AOP6: Flood Risk Watch Project for Life-saving	Japan	0
7	AOP7: Platform on Water Resilience and Disaster under IFI	Japan	0
	Total		25000



5. Finalize the proposal of Chairmanship for WGH

- 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.
- The participants reviewed and discussed (a) the Summary of Feedback on WGH Chairmanship from Members, and (b) Final Summary of WGH Chairmanship.
- 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 next February.
 - WGH Participants agreed to formulate an agreeable approach for future recommendation of appointment of Chairpersons and Vice Chairpersons for WGH before 53rd Session.

6. Recommendations to the Committee

- 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\$10,000 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) IFI based Platform on Water Resilience and Disaster led by Japan from 2019 to 2022 as a cross-cutting project
- 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.



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Thank you very much !

