6^{th} ICHARM Governing Board Meeting

Material Contents

ICHARM 6th Governing Board Meeting

Date: June 21, 2022, Tuesday, 16:00-18:00

Venue: TKP Ichigaya Conference Center and Web Meeting

Agenda (Tentative):

- Opening by Chairperson, President of PWRI
- Self-introduction by Governing Board Members
- Adoption of Rules of procedures for ICHARM Governing Board
- Examination and adoption of ICHARM Program
- Examination of ICHARM Activity Report
- Examination and adoption of ICHARM Work plan
- Closing

6th ICHARM Governing Board Meeting
List of Participants

(Alphabetically order of the organization)

Nobuhiro HOSOE

Vice President, National Graduate Institute for Policy Studies (GRIPS)

Eiji IWASAKI

Director General of Global Environment Department, Japan International Cooperation Agency (JICA), on behalf of Mr. Akihiko TANAKA, President, JICA

Mikio YOSHIOKA

Vice Minister for Engineering Affairs, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

Koichi FUJITA (Chairperson)

President, Public Works Research Institute (PWRI)

Yuki MATSUOKA

Head of the United Nations Office for Disaster Risk Reduction (UNDRR) Office in Japan, on behalf of Ms. Paola ALBRITO, Chief of Branch, Intergovernmental Processes, Interagency Cooperation and Partnerships, UNDRR

Shamila NAIR-BEDOUELLE

Assistant Director-General for Natural Sciences, on behalf of Ms. Audrey AZOULAY, Director-General, United Nations Educational, Scientific and Cultural Organization (UNESCO)

Kaoru TAKARA

Professor, Kyoto University, on behalf of Mr. Yasuto TACHIKAWA, Chair Holder, Research and Educational Unit of UNESCO Chair on Water, Energy and Disaster Management (WENDI)

Johannes CULLMANN

Director, Water and Cryosphere, on behalf of Ms. Elena MANAENKOVA, Deputy Secretary-General, World Meteorological Organization (WMO)

(Secretariat)

Yasuhito SASAKI, Vice President, PWRI

Toshio KOIKE, Executive Director, ICHARM

Shinji EGASHIRA, Research and Training Advisor, ICHARM

Hirotada MATSUKI, Deputy Director of ICHARM,
Director of Water-related Hazard Research Group, PWRI

Tetsuya IKEDA, Deputy Director of ICHARM (International Coordination),
Director for Special Research, PWRI

Naoko NAGUMO, Research Specialist, ICHARM, PWRI

Rules of Procedure for ICHARM Governing Board

Article 1 Intent

These Rules of Procedure (hereinafter referred to as “the Rules”) shall state the necessary matters which shall guide proceedings of the International Centre for Water Hazard and Risk Management (ICHARM) Governing Board (hereinafter referred to as “the Governing Board”) meeting, subject to Article 6 of the agreement between the Government of Japan and the United Nations Educational, Scientific and Cultural Organization (UNESCO) regarding the continuation, in Japan, of the International Centre for Water Hazard and Risk Management (category 2) under the auspices of UNESCO, signed on 13 February 2020 (hereinafter referred to as “the Agreement”).

Article 2 Composition

1) The members of the Governing Board will be composed as provided for by Article 6 of the Agreement. The President of the National Research and Development Agency Public Works Research Institute, Japan will be designated as Chairperson of the Governing Board.
2) The members of the Governing Board shall be appointed by the Chairperson.
3) The term of office for each Governing Board member appointed by the Chairperson shall be three years. This term may be extended by re- appointment.

Article 3 Board Meetings, Quorum, and Minutes

1) The functions of the Governing Board shall be prescribed as provided for by Article 6 of the Agreement.
2) The Chairperson shall convene the Governing Board meeting. Participation by a majority of Governing Board members shall be necessary to proceed with the Governing Board meeting.
3) The majority agreement of all attendees shall be necessary for the adoption.
4) The official language of the Governing Board meeting shall be English.
5) The secretariat of the Governing Board (referred to in Article 4) shall take minutes of the Governing Board meetings.

Article 4 Secretariat

ICHARM shall function as the secretariat of the Governing Board.

Article 5 Amendment of the Rules

The Rules may be amended during a Governing Board meeting by consent of the majority of attendees. The Chairperson can ask for electronic votes when urgent decision issues relevant to the Rules arise between meetings. The decisions in such cases shall be made by consent of the majority of the members who have voted by deadlines.

Article 6 Miscellaneous Provisions

Miscellaneous provisions necessary for the management of the Governing Board but not included in the Rules shall be decided by the Chairperson in consultation with the Governing Board members.

Supplementary Provisions

The Rules shall be enacted on 21 June 2022.

ICHARM Program

1. Mission of ICHARM

The mission of ICHARM is to serve as the Global Centre of Excellence for Water Hazard and Risk Management by, inter alia, observing and analyzing natural and social phenomena, developing methodologies and tools, building capacities, creating knowledge networks, and disseminating lessons and information in order to assist governments and all stakeholders in managing risks of water-related hazards at global, national, and community levels. The hazards to be addressed include floods, droughts, landslides, debris flows, tsunamis, storm surges, water contamination, and snow and ice disasters.

We envision a Center of Excellence housing a group of leading experts, superior facilities, and a knowledge base, which conducts (1) innovative research, (2) effective capacity building, and (3) efficient information networking. Based on these three pillars, ICHARM will globally serve as a knowledge hub for best national and local practices and a policy-making advisor, keeping in mind respect for diversity and inclusion of all stakeholders.

2. Long-term Programme (around 10 years)

The UN 2030 Agenda for Sustainable Development stresses the transition to a sustainable and resilient path. The UN Sendai Framework for Disaster Risk Reduction highlights four priority areas. Both aim to achieve their goals by 2030. The ninth phase of the UNESCO Intergovernmental Hydrological Programme (IHP-IX), which aims to establish adequate capacity and scientifically-based knowledge for informed decision-making on water management and governance to attain sustainable development and build resilient societies, has identified five priority areas and started activities in research and education, which will continue for eight years until 2029. The sixth Assessment Report of the International Panel on Climate Change addresses linkages between mitigation, adaptation, and sustainable development.

In Japan, in an effort to address increasingly intense water-related disasters as the climate changes, a group of experts recommended reviewing conventional flood control planning based on the findings of advanced climate science and proposed shifting to “River Basin Disaster Resilience and Sustainability by All,” a new flood control approach aiming to enhance communities’ resilience to water disasters and their sustainability. In response to the proposal, the national government has reformed the legal framework and planned investment strategies. River administrators around the nation have started revising long-term river management policies and rewriting mid-term river improvement plans. At the same time, the national government has adopted Society 5.0, a new science promotion policy, creating the Digital Agency and accelerating digital transformation in society.

As one of the research groups of the Public Works Research Institute, which has led technological development to protect human lives and assets from severe water-related disasters for over a century, ICHARM will contribute to achieving “River Basin Disaster Resilience and Sustainability by All” by creating and sharing scientific knowledge to enhance both resilience and sustainability and strengthening society's disaster coping capacity. In parallel, we will implement the goals of the IHP-IX five priority areas and assist nations around the world in achieving the targets of the 2030 Agenda and the Sendai Framework by enhancing our international information network to better understand water-related disasters in regions and nations, training human resources who can contribute to building a resilient, sustainable society, and sharing scientific knowledge learned from Japan's experience.

To achieve all these goals, ICHARM will step up innovative research by taking an End-to-End approach, which covers the entire research process from data collection to analysis, assessment and prediction of natural phenomena to socio-economic impact assessment, thereby creating a scientific knowledge base, which helps increase communities' water-related disaster resilience and sustainability. We will conduct more advanced research by collecting data on both water hazards and disaster risks, assessing and predicting risks and their changes, including those likely to affect society and the economy, and establishing methods and applications to support on-site policy implementations. We will promote interdisciplinarity by collaborating with a broad range of areas, including water utilization, public sanitation, climate science, urban planning, biology, biodiversity, agriculture, energy, and infection control, as well as by considering new lifestyles and national land development.

ICHARM will also improve its capacity building programs to help local experts further develop capacities needed, for example, to solve problems based on local needs and conditions and form a consensus among various stakeholders. We will provide graduate-level programs to foster practitioners who can understand and create scientific knowledge on water hazard and risk management. We will also offer training for local experts to become "facilitators" who can provide practical ideas on site to improve resilience and sustainability by utilizing the water disaster consilience.

Promoting information networking, ICHARM will continue updating the action plans by identifying, visualizing and mapping challenges to be addressed to achieve the resilience and sustainability goals listed in the 2030 Agenda, the Sendai Framework, the IHP-IX, and "River Basin Disaster Resilience and Sustainability by All." We will also continue implementing projects while incorporating the outcomes of research and capacity building by utilizing the International Flood Initiative and other networks.

(1) Innovative research

1) Data collection, storage, sharing, and statistics on water-related disasters

It is often difficult for developing countries to formulate effective disaster management plans suitable for the characteristics of water-related disasters and local-specific natural and social conditions. This can be attributed to insufficient systems to collect, store, share and statistically process data on disaster damage and hydrological and meteorological events. Recognizing these shortcomings as the most fundamental bottlenecks to promoting disaster risk reduction, ICHARM will implement research on data management technology for water-related disasters as one of its major research themes. In addition, understanding the importance of a cross-sectoral approach in the public sector and active participation of the private sector, ICHARM will integrate interdisciplinary scientific knowledge to consolidate a consilience for water disaster reduction.

In particular, ICHARM conducts research on technologies to collect and store data and information regarding hazards, exposure and vulnerability and share them among stakeholders while developing and implementing technologies to collect damage data that can be operated at national and local levels. ICHARM will also develop a method for combining local data with satellite observations and numerical model outputs to provide wide-area information in order to encourage nations and regions to store and share information and data. We will provide technical assistance for affected nations to compile highly reliable disaster statistics, to which stakeholders can have access in real time. Moreover, ICHARM will assemble intelligence infrastructure using digital twin technology to integrate and share policies and other information on areas closely related to water disasters, such as urban planning, agriculture, energy, natural environment, and infection control.

ICHARM will continue its contribution to research on data collection, storage, sharing, statistics, and visualization as the most fundamental infrastructure to enhance disaster risk reduction.

2) Risk assessment on water-related disasters

ICHARM has been developing hazard assessment methods separately, such as the Integrated Flood Analysis System (IFAS), the Water-Energy-Budget Rainfall-Runoff-Inundation model (WEB-RRI), a sediment-driftwood-inundation analysis system, and the Couple Land and Vegetation Data Assimilation System (CLVDAS), and vulnerability assessment methods, such as an economic damage analysis system. However, for all basin stakeholders to understand risks and share information, it is essential to conduct integrated assessments of hazards, exposure and vulnerability and interlink the outcomes with those of impact assessments in such areas as urban planning, agriculture, energy, and natural environment conservation.

ICHARM will develop and verify a method to combine water-related disaster assessment models with other models. We will also develop an index that can holistically indicate the basin-wide impact of water hazards. Case studies on the risk assessment of water-related disasters will be conducted at multiple locations both in and outside Japan while taking local conditions into account. Necessary assistance will be provided for local communities to perform risk assessments based on their needs and circumstances using the findings of the case studies, thereby achieving disaster risk reduction. Additionally, since monitoring methods for the global targets listed in the Sendai Framework have not been established, ICHARM will contribute to developing a globally applicable methodology by conducting case studies and comparing their results.

ICHARM will continue creating relevant information and providing support for better communication and understanding of water-related risks.

3) Monitoring and prediction of changes in water-related disaster risk

Water-related disaster risks change over time as hazards become intense due to climate change and vulnerability increases due to urbanization and infectious diseases spreading worldwide. When risks increase, prevention measures designed based on present risk information may not be effective for future disasters. Furthermore, if the effect of prevention measures to be taken for increased risks is not projected properly, the economic efficiency of disaster-related investment might be underestimated. To avoid such misperceptions, ICHARM will continue research on forecasting future risks while additionally considering their changes observed until the present.

We will develop, verify, and improve methods for monitoring and forecasting changes in hazards due to meteorologic conditions with different temporal scales ranging from season to climate change and changes in exposure and vulnerability due to social development and economic changes. Case studies will be conducted using these methods to support local communities in selecting appropriate methods according to their needs and conditions to mitigate future risks by themselves. The methods will be modified with various local adjustments and compared with each other for further improvement to eventually become globally applicable.

ICHARM will continue its contribution to effective policymaking for disaster risk reduction as water-related risks are projected to increase.

4) Proposal, evaluation, and application of policy ideas for water-related risk reduction

Irrationally low priority on investment in disaster risk reduction causes many disasters and disturbs sustainable economic activities in developing countries. Japan, promoting "River Basin Disaster Resilience and Sustainability by All" as its new flood control policy, is seeking a method to explain the relationship between disaster-related investment and regional management. This needs an interdisciplinary approach and collaboration between the public and private sectors, and facilitating these efforts requires illustrating the effectiveness and efficiency of disaster-related investment. To this end, ICHARM will conduct research by proposing and evaluating policies aiming to reduce water-related disaster risks while considering local needs and conditions.

The research will seek to increase stakeholders' understanding of the significance of disaster risk reduction policies to support sustainable development under climate change. It will also analyze concrete policies in terms of suitability to the target, aiming to assist each nation in proposing new policies independently while considering local lifestyles, socio-economic activities, and future risk changes. ICHARM will also develop models to evaluate each policy's outcomes and socio-economic assessment methods applicable to different nations, as well as provide training for strengthening human resources to lead local consensus building and political decision making.

ICHARM will continue supporting local and national governments and funding agencies in active decision making on investment in disaster risk reduction.

5) Support in improving the applicability of water-related disaster management

Although some cases have reported that disaster reduction measures were highly effective, other cases have reported unfortunate incidents in which malfunctioning crisis communication caused fatal delays in evacuation.

The need has also been pointed out for building a flood-conscious society, in which communities prepare appropriate rescue and recovery schemes even during unexpectedly large-scale disasters and a build-back-better framework based on a long-term regional management plan. This needs technical support to increase the awareness of local governments and residents about disaster prevention and mitigation and for them to create systems to take necessary actions. With a wide understanding of local conventions and human behavior in emergencies, ICHARM will develop, verify, and help local governments and residents plan and implement a wide range of disaster management measures with a good consensus among relevant stakeholders so that measures will maximize their effects during disasters.

Such measures will aim to support the effective sharing of information provided from early warning systems and other sources among administrators and residents to facilitate coordinated disaster responses among different sectors. They will also aim to help them with operation continuity planning based on local needs and conditions and interoperability improvement for better collaboration among various administrative functions.

ICHARM will support citizens and local governments in increasing disaster awareness and improving their water-related disaster management capabilities.

(2) Effective capacity building

1) Foster solution-oriented practitioners and Training-of-Trainers (TOT) instructors who will contribute effectively to the planning and implementation of disaster management with solid theoretical and engineering competence at all levels from local to international.
2) Train facilitators to acquire interdisciplinary scientific knowledge related to water-related disaster risk reduction and the capability to lead consensus building among various stakeholders.
3) Maintain and enhance the capacity of local experts and institutions engaged in addressing water-related risks using accumulated knowledge and skills both in research and practice. ICHARM will support a global network of exemplary practitioners involved in water hazard and risk management.

(3) Efficient information networking

1) Accumulate, analyze and disseminate major water-related disaster records and experiences by maintaining and upgrading a worldwide practitioners' network.
2) Integrate interdisciplinary scientific knowledge into a consilience of water-related risk management as a common asset of practitioners.
3) Mainstream water-related disaster risk reduction by facilitating active collaboration and communication among experts and organizations through sharing cases and findings in water-related hazard and risk management.

3. Mid-term Programme (around 6 years)

In order to achieve the Mission in step with the UNESCO IHP-IX and the fifth Medium to Long-term Plans of the Public Works Research Institute (PWRI), ICHARM will conduct the following activities in the next 6 years:

(1) Innovative research

1) Data collection, storage, sharing and statistics on water-related disasters

ICHARM will conduct research on technologies to collect and store data and information regarding hazards, exposure and vulnerability and share them among stakeholders. We will also actively support nations and communities in data collection, storage, and sharing by developing and helping them implement technologies to collect damage data that can be operated by themselves. Technical assistance will also be provided for nations to compile highly reliable statistical data.

2) Risk assessment on water-related disasters

ICHARM will develop and verify a method to combine water-related disaster assessment models with other models. We will also develop an index that can holistically indicate the basin-wide impact of water hazards. Case studies on the risk assessment of water-related disasters will be conducted at multiple locations both in and outside Japan while taking local conditions into account. Necessary assistance will be provided for local communities to perform risk assessments based on their needs and circumstances using the findings of the case studies, thereby achieving disaster risk reduction.

3) Monitoring and prediction of changes in water-related disaster risk

ICHARM will develop, verify and improve methods for monitoring and forecasting changes in hazards due to meteorological conditions with different temporal scales ranging from season to climate change and changes in exposure and vulnerability due to social development and economic changes. These methods will be applied to case studies at multiple locations both in and outside Japan, and the outcomes will be used to provide support for all stakeholders to select appropriate methods according to their needs and conditions to mitigate future risks of water-related disasters by themselves. The methods will be modified with various local adjustments and compared with each other for further improvement to eventually become globally applicable.

4) Proposal, evaluation and application of policies for water-related disaster risk reduction

When developing policies that are practical under climate change, it is essential to consider stakeholders' understanding of disaster risk reduction measures, lifestyles, socio-economic activities, and possible changes in disaster risks. To achieve these, ICHARM will develop models to evaluate each policy's outcomes and socio-economic assessment methods applicable to different nations, as well as provide training for strengthening human resources to lead local consensus building and political decision making.

5) Support in constructing the applicability of water-related disaster management

ICHARM will support local governments and citizens at several locations in Japan and overseas in the implementation of means for effectively sharing information from early warning systems and other sources among administrators and residents to facilitate coordinated disaster responses among different sectors. We will also develop, verify, and help them implement methods for preparing operation continuity plans based on local needs and conditions and improving interoperability during disaster response by liking administrative functions effectively at all levels.

(2) Effective capacity building

1) Foster solution-oriented practitioners and Training-of-Trainers (TOT) instructors who will contribute effectively to the planning and implementation of disaster management with solid theoretical and engineering competence at all levels from local to international.

In closer collaboration with GRIPS and JICA, ICHARM will continue its master's and doctoral programs in water-related disaster management, as well as short-term capacity development training programs. The programs, particularly at the Ph.D. level, are integrated seamlessly with ICHARM research activities by creating new opportunities for student involvement, supporting mentorship of ICHARM researchers, and offering more flexible and efficient training as a module or package in e-learning or remote style.

2) Train facilitators to acquire interdisciplinary scientific knowledge related to water-related disaster risk reduction and the capability to lead consensus building among various stakeholders.

It is important to increase the understanding and collaboration of all stakeholders in river basins to build resilience and sustainability against increasingly intense water-related disaster risks. ICHARM will foster facilitators who can integrate and translate interdisciplinary scientific knowledge for all stakeholders to cooperate in building social consensus by employing a cross-sectoral approach in the public sector and encouraging the private sector for active participation.

3) Maintain and enhance the capacity of local experts and institutions engaged in addressing water-related risks using accumulated knowledge and skills both in research and practice. ICHARM will support a global network of exemplary practitioners involved in water-related hazard and risk management.

Offering opportunities to research and practice water-related disaster management, ICHARM will support the graduates from its educational and training programs to become a leader in promoting water hazard and risk management in their own localities. The ICHARM alumni network across the globe has been facilitated through follow-up meetings and created knowledge hubs to contribute to water-related risk reduction around the world.

(3) Efficient information networking

1) Accumulate, analyze and disseminate major water-related disaster records and experiences by maintaining and upgrading a worldwide practitioners' network.

ICHARM, as the global knowledge center for water hazards, will be working closely with the UNESCO IHP, the World Meteorological Organization (WMO), the Typhoon Committee (TC), the International Flood Initiative (IFI), and other domestic and international agencies, exchanging data, information, lessons and ideas regarding water-related disasters. By hosting and organizing International academic meetings, ICHARM will continue offering a place to collect and disseminate the most advanced knowledge for researchers around the world.

2) Integrate interdisciplinary scientific knowledge into a consilience of water-related risk management as a common asset of practitioners.

ICHARM will establish a system to collect accurate data and information by strengthening collaboration with organizations collecting and archiving scientific data, information and knowledge on water-related disasters and nations co-hosting ICHARM's training and research projects. Collected data and information will be sorted out and accumulated as meta-data and integrated into a "consilience of water-related disaster risk management" as a common asset of practitioners.

3) Mainstream water-related disaster risk reduction by facilitating active collaboration and communication among experts and organizations through sharing cases and findings in water-related hazard and risk management.

ICHARM will continue contributing to worldwide efforts in implementing and mainstreaming disaster risk reduction in step with the Sendai Framework and the Sustainable Development Goals (SDGs), both adopted in 2015. By enhancing research, capacity building, and networking, we will continue stressing the importance of water-related disaster risk reduction and promoting the creation of a resilient, sustainable society by involving all stakeholders at local, national, and international levels.

ICHARM Activity Report

FY2020-2021

For the 6th ICHARM Governing Board

On 21 June 2022

International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM),
Public Works Research Institute (PWRI), Japan

Contents

Abbreviation

ADB	Asian Development Bank
ADBI	Asian Development Bank Institute
ADCP	Acoustic Doppler Current Profiler
ADRC	Asian Disaster Reduction Center
AGRHYMET	AGRrometeorology, HYdrology, METeorology
AMSR2	Advanced Microwave Scanning Radiometer 2
AOGEO	Asia-Oceania Group on Earth Observations
AOP	Annual Operating Plan
APFM	Associated Programme on Flood Management
APWF	Asia-Pacific Water Forum
APWS	Asia-Pacific Water Summit
Area-BCM	Area- Business Continuity Management
ASEAN	Association of South-East Asian Nations
AWCI	Asian Water Cycle Initiative
BOSS	Bosai-Business Operation Support System
CCA	Climate Change Adaptation
CHy	Commission of Hydrology
CLVDAS	Couple Land and Vegetation Data Assimilation System
COVID-19	COVID-19
DIAS	Data Integration and Analysis System
DRR	Disaster Risk Reduction
DSM	Digital Surface Model
EDITORIA	Earth Observation Data Integration and Fusion Research Initiative
ET	Evapotranspiration
FEWS	Flood Early Warning System
GCM	General Circulation Models
GCOM-W	Global Change Observation Mission – Water
GEOSS	Global Earth Observation System of Systems
GRIPS	National Graduate Institute for Policy Studies
GSMaP	Global Satellite Mapping of Precipitation

GUI	Graphical User Interface
GWP	Global Water Partnership
HCP	Hydrological Coordination Panel
HELP	High-level Experts and Leaders Panel on Water and Disasters
HLPF	High Level Political Forum
HLPW	High Level Panel on Water
HMD	Head Mounted Display
IAEA	International Atomic Energy Agency
IAHS	International Association of Hydrological Sciences
ICFM	International Conference on Flood Management
ICHARM	International Centre for Water Hazard and Risk Management
ICoE	International Centres of Excellence
IDI	Infrastructure Development Institute
IDRIS	ICHARM Disaster Risk Information System
IFAS	Integrated Flood Analysis System
IFI	International Flood Initiative
IGC	Intergovernmental Council
IRDR	Integrated Research on Disaster Risk
IRDR Japan NC	IRDR Japan National Committee
IRDR SC	IRDR Scientific Committee
iRIC	International River Interface Cooperative
IWS	Integrated Workshop
JAXA	Japan Aerospace Exploration Agency
JHoP	Japan Hub of Disaster Resilience Partners
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
JST	Japan Science and Technology Agency
LAI	Leaf Area Index
LDAS-UT	Land Data Assimilation System of The University of Tokyo
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MoC	Memorandum of Cooperation

MOFA	Ministry of Foreign Affairs
MoU	Memorandum of Understanding
MRI-AGCM	Meteorological Research Institute - Atmospheric General Circulation Model
NBA	Niger River Basin Authority
NGO	Non-Governmental Organization
NIED	National Research Institute for Earth Sciences and Disaster Resilience
NILIM	National Institute for Land and Infrastructure Management
OEWG	Open Ended Working Group
OSS-SR	Online Synthesis System for Sustainability and Resilience
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PF	Particle Filter
PRISM	Public/Private R&D Investment Strategic Expansion Program
PTC	Panel on Tropical Cyclones
PWRI	Public Works Research Institute
RCA	Regional Cooperative Agreement
R&D Seminar	Research and Development Seminar
RRI	Rainfall-Runoff-Inundation
RSC-AP	Regional Steering Committee for Asia and the Pacific
RTC	Regional Training Course
S&T Panel	Science and Technology Panel
SAR	Synthetic Aperture Radar
SATREPS	Science and Technology Research Partnership for Sustainable Development
SBP	Support Base Partner
SCJ	Science Council of Japan
SDGs	Sustainable Development Goals
SIMRIW	Simulation Model for Rice-Weather Relationships
SIP	Cross-ministerial Strategic Innovation Promotion Program
SNS	Social Networking Service
SPADE	Spatial Data Analysis Explorer
SWWW	Stockholm World Water Week
TC	Typhoon Committee

TOUGOU	Integrated Research Program for Advancing Climate Models
UCCR	Urban Climate Change Resilience
UNCRD	United Nations Center for Regional Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHP	UNESCO- Intergovernmental Hydrological Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNSTSWD	United Nations Special Thematic Session on Water and Disasters
UNWCDRR	United Nations World Conference on Disaster Risk Reduction
VBA	Volta Basin Authority
VR	Virtual Reality
WADiRe-Africa	Water Disaster Platform to Enhance Climate Resilience in Africa
WBF	World BOSAI Forum
WEB-DHM	Water and Energy Budget-based Distributed Hydrological Model
WEB-DHM-S	Water and Energy Budget-based Distributed Hydrological Model-Snow
Web-GIS	Web Geographic Information System
WEB-RRI	Water and Energy Balance-based Rainfall Runoff Inundation
WGDRR	Working Group on Disaster Risk Reduction
WGH	Working Group on Hydrology
WGM	Working Group on Meteorology
WMO	World Meteorological Organization
WRF model	Weather Research and Forecasting model
WWAP	World Water Assessment Programme
WWDR	World Water Development Report
WWF	World Water Forum
X Band MP Radar	X-band polarimetric Multi Parameter Radar

１． Introduction

1.1 Research

1.1.1 Data collection, storage, sharing and statistics on water-related disasters

In collaboration with the EDITORIA of the University of Tokyo, ICHARM established the Flood Early Warning System (FEWS) for the Niger and Volta river basins in West Africa. FEWS aims to share information among 11 West African countries and related organizations, such as the AGRHYMET, the NBA, and the VBA.

ICHARM also studied how to optimize the distribution and number of ground rain gauges in the Fuji River basin by performing runoff analysis using GSMaP, to which multiple correction methods were applied. Regarding the correction of real-time satellite precipitation products, ICHARM demonstrated that runoff analysis can be conducted with reasonable accuracy, provided that there are a certain number of ground rain gauges in the basin.

1.1.2 Water-related disaster risk assessment

ICHARM developed a new function that can calculate the behavior of flood, sediment, and flood inundation in real time on DIAS. For this new function, we developed a method to set the upper boundary condition of an inundation area by coupling a real-time flood forecasting method, which uses the RRI model with a particle filter, with an integrated RRIS model, which was developed to analyze basin sediment discharge. The upper boundary condition calculated using this new method is used for a 2D analysis model using iRIC-Nays2DH A to finally predict the behavior of flood, sediment, and flood inundation in real time.

ICHARM also established WEB-DHM-S for the power generation dam basins of the Oi and Sai Rivers in Japan. For the effective use of this model, ensemble inflow prediction and a new dam operation method were also proposed and applied. Ensemble inflow prediction uses ensemble weather forecasting data as inputs, and the new dam operation method uses the predicted inflow for more stable flood control and higher power generation.

Moreover, focusing on the flooding caused by an earth-dam failure in Myanmar in 2018, ICHARM developed a runoff inundation model to analyze changes in dam inflow and storage level and downstream inundation due to the dam failure. Spatiotemporal rainfall data were produced and the inundation areas were identified using satellite data available worldwide, and the reproducibility of the inundation was verified. Flood simulation was conducted for rainfalls of different occurrence probabilities, and the results were used to propose an inundation estimation method useful for risk management at the time of dam failure in areas where hydrological data is scarce.

1.1.3 Monitoring and predicting changes in water-related disaster risks

ICHARM conducted dynamical downscaling of future precipitation data for the Solo and Davao River basins, using the MRI-AGGM3.2S/3.2H model and the future climate scenarios of RCP8.5

and RCP 2.6. Furthermore, as well as establishing a WEB-RRI model for each river basin, ICHARM predicted hydraulic and hydrological phenomena using future precipitation data and carried out flood and drought risk assessments.

For West Africa, ICHARM developed a drought monitoring system using the CLVDAS, which integrates passive microwave remote sensing technology, a land surface model, a vegetation dynamics model, and a data assimilation method.

1.1.4 Presentation, evaluation and support for implementation of water-related disaster risk mitigation measures

In order to provide information that prompts residents living near small and medium rivers to start early evacuation, ICHARM developed a simple, low-cost system capable of predicting water levels with adequate accuracy and short computation time. The system can predict when the river water will reach the flood level more than two hours in advance and is easy to install in small and medium rivers. Its runoff analysis model adopted the RRI model capable of representing runoff phenomena, such as surface and subsurface runoff, with fewer parameters to be adjusted, so that water level prediction is possible using radar-rain gauge analyzed precipitation and short-term precipitation forecasts, both of which are provided in real time by JMA. Furthermore, in order to accurately and quickly represent ever-changing rainfall-runoff mechanisms, the SCE-UA method is applied as an automatic parameter adjustment function. A particle filter was also introduced to improve the RRI model by sequentially modifying a water level prediction model using real-time water level observation data. Moreover, ICHARM has experimentally produced a real-time automatic calculation, representation and distribution system and has been distributing river-related information while testing the developed systems with about 130 river models.

1.1.5 Support for improving the capacity to practice disaster prevention and mitigation

ICHARM developed a portal site for local governments in mountainous areas where residents have little access to information needed to make informed evacuation decisions. The portal site was developed to be a one-stop information center and designed not only to be useful in emergencies but also to improve residents' ability of disaster management in normal times. The system has been improved for smartphone use. We have also started developing a virtual flood experience system using virtual reality (VR) technology, creating a virtual flood situation based on the actual event in Aga Town, Niigata Prefecture, Japan, during Typhoon No. 19 in 2019 and the experiences and feedback of local residents.

In another project, we conducted research on businesses affected by heavy rains in the Kanto and Tohoku regions in 2015 and Hiroshima and Okayama prefectures in western Japan in 2018. We found that many businesses needed a long time to return to their pre-disaster business level. In a different project, we studied the recovery curve of housing reconstruction, daily life, and community activities by conducting questionnaire surveys for residents in Joso City, Ibaraki Prefecture, who suffered significant damage during the Kanto and Tohoku heavy rains, and residents in Iwaizumi Town, Iwate Prefecture, who were also severely affected by Typhoon No. 10 in 2016. In the process of developing a simple method for estimating the socio-economic impact of flood disasters, we investigated the relationship between changes in GDP and the regional GDP of prefectures and municipalities and flood damage.

Furthermore, in order to improve the disaster prevention capabilities of local governments, we published and disseminated the "Collection of Critical Situation during Flood Emergency Response" on various occasions.

In an effort to support disaster prevention and mitigation activities overseas, we promoted OSS-SR, developing an "Online Synthesis System" and training "Facilitators" in Davao City, Philippines. We also assisted Thailand in strengthening regional resilience by developing Area-BCM for regional business continuities in industrial clusters. Furthermore, we have started "The Project for Development of a Hybrid Water-Related Disaster Risk Assessment Technology for Sustainable Local Economic Development Policy under Climate Change in the Republic of the Philippines." for Luzon Island, Philippines.

1.2 Education and training

ICHARM has provided educational and training programs that are designed to strengthen the capabilities of both individuals and organizations in disaster management.

The main programs include: 1. One-year master's degree program, "Water-related Risk Management Course of Disaster Management Policy Program," conducted in collaboration with GRIPS and JICA; 2. Three-year doctoral degree program, “Disaster Management Program” jointly conducted with GRIPS; 3. Short-term training programs held in Japan and overseas; 4. Follow-up Seminar held annually overseas for graduates and trainees; and 5. Short- and long-term internship programs.

From 2020 to 2021, due to the spread of COVID-19, various restrictions were put in place, affecting our programs significantly. For example, students could not come to Japan as scheduled, and some study trips and the follow-up seminar were canceled.

Under these circumstances, ICHARM introduced an electronic blackboard for the master's program in advance of the pandemic and established a system that allows students to take lectures online in real time from their home countries during the period when students cannot come to Japan. In addition, we used whatever measures possible to keep the programs going. For example, we introduced a flexible lecture system in which we flexibly chose a different lecture style from face-to-face, remote, and a combination of the two types, depending on how severely the infectious disease was affecting society, while thoroughly practicing infection control measures such as installing partitions and keeping hand sanitizers around.

In 2018, JICA started a new scholarship program, “Disaster Risk Reduction Leaders Capacity Development for the Sendai Framework Implementation,” for doctoral students. One student enrolled in 2020 and two students enrolled in 2021 have been using this JICA scholarship. The program will continue to be available for new students wishing to study at ICHARM.

1.3 Information networking

ICHARM continues promoting information networking on a global scale. As a UNESCO category 2 center, it keeps close ties with the UNESCO-IHP and its National Committees, other UNESCO category 2 centers, and the UNESCO Chairs. It also maintains cooperative relations with UN organizations, such as WMO and UNDRR, and other international and regional organizations, such as the TC.

As the secretariat of IFI, ICHARM is promoting the global effort to establish Platforms on Water Resilience and Disasters based on the Jakarta Statement, which was adopted as the basic action plan of IFI after the elaborations at the October 2016 workshop in Jakarta, Indonesia, and the January 2017 workshop in Tokyo, Japan. ICHARM has been supporting the establishment of Platforms on Water Resilience and Disasters in the Philippines, Sri Lanka, Indonesia, and some other countries.

Since the spring of 2020, ICHARM staff have been obliged to refrain from any business trips abroad, as most international conferences have been canceled or held online to prevent the COVID-19 pandemic. Even under such difficult situations, e-learning sessions and related online workshop programs were held for the Philippines and Indonesia, gathering participants from the relevant organizations of the IFI Platforms. These efforts have been kept underway and supported countries in developing the OSS-SR and fostering facilitators.

In Asia, the AWCI sessions were convened online on February 26, 2021, as the task group of the 13th AOGEO, and on October 29, 2021, as a sectional meeting of the 14th AOGEO, attended by the representatives of the Platform participating organizations from the IFI implementing countries, such as the Philippines, Sri Lanka, and Indonesia. At the AWCI sessions, each country reported on the implementation status and future plans. The sessions also covered cutting-edge research and development topics. The outcomes of the sessions were included in the final statements of AOGEO.

Also, an ICHARM researcher assumes the chair of WGH in TC, which is an intergovernmental community jointly organized by UNESCAP and WMO. ICHARM is playing the leading role in the implementation of the AOPs in collaboration with the TC members.

On a global scale, the UNSTSWD5 was held on June 25, 2021. Prior to it, ICHARM organized the S&T Panel, whose discussion summary was reported at the UNSTSWD5. The outcomes are expected to be reported at coming global milestone events, including the mid-term review processes on the SDGs and the Sendai Framework on Disaster Risk Reduction 2015-2030.

In close partnership with relevant organizations, ICHARM is eagerly engaged in preparatory activities as a session organizer of water and disasters/climate change for the 4th APWS to be held in April 2022 and as a conference organizer of ICFM9 in February 2023.

Even during the COVID-19 pandemic, ICHARM participated in major conferences and hosted sessions and side events through web systems, which strengthened the relationships with other participants and organizations and expanded its professional and organizational networks.

２． Special topics

2.1 UNESCO project, "Water Disaster Platform to Enhance Climate Resilience in Africa" (WADiRe-Africa)

In collaboration with the UNESCO-IHP and the AGRHYMET in West Africa, ICHARM established the FEWS in the Niger and Volta River basins in West Africa (see 3.1). We conducted e-learning capacity building training for local staff to become able to utilize the FEWS for disaster response.

Initially, the training was planned to be carried out face-to-face in West Africa, but the spread of the COVID-19 infection made it impossible for ICHARM staff to travel to the site. Thus, e-learning was the only option left to materialize the capacity building training during the project period, considering the local conditions in West Africa; for example, the Internet connection was not always stable to provide online, real-time classes, and many target countries were French-speaking countries. A special website was set up on DIAS so that training participants could study offline by downloading training materials pre-recorded in English and French.

The training was held from August 2020 to February 2021. Two types of training courses were conducted for representatives from the NBA, the VBA, and 11 countries located in either river basin. One was the "Expert Training" and the other "Training of Trainers (ToT)," which was a more advanced course targeted at the experts nominated by AGRHYMET among those who had completed the Expert Training.

In the Expert Training, the participants first learned offline using audio materials recorded in English and French. The topics included climate change and flood mitigation, hydrological processes and modeling, and flood mapping and response planning. Then, they created a local RRI model and a timeline for action using technical materials and attended online question-and-answer sessions. In the Training of Trainers, the participants learned offline using materials prepared in English and French about the design of flood response workshops for local residents and then attended online question-and-answer sessions and discussions. Each participant had to compile a concept note.

Those who passed the proficiency test were certified for the completion of the training course. The Expert Training was held four times, which 197 out of 288 participants completed. The Training of Trainers was held twice, which 30 out of 44 participants completed.

ICHARM has three pillars of activity: (1) innovative research, (2) effective capacity building, and (3) efficient networking. In this project, ICHARM carried out innovative research, such as establishing FEWS using data provided by the AGRHYMET and other organizations, and utilized the results for capacity building for related organizations to create a new network. This is a good example of embodying the triangle of the three pillars.

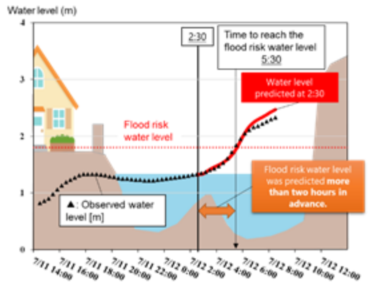
E-learning training

2.2 Development of a simple, low-cost flood forecasting system for small and medium rivers

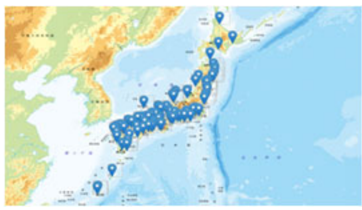
Water level forecasting, which provides important information for making decisions on evacuation and other orders, is mainly conducted for large rivers and has not been practiced for many small and medium rivers across Japan. Consequently, many people reside along such rivers, while exposed to a high risk of severe damage once they flood. Although it is necessary to predict water levels in these rivers to support the evacuation of residents, few water level gauges are installed along them. Therefore, the MLIT has started promoting the installation of low-cost water level gauges specifically for water level observation during floods. The gauges are designed to be smaller and less costly, using fewer communication devices. In small and medium river basins, the flood arrival time from the beginning of heavy rainfall is often short.

To ensure safe evacuation, it is important to predict water levels as far in advance as possible and support as early decision-making and action as possible. Therefore, this R&D project aimed to develop a simple, low-cost, and accurate water level forecasting system with a short computation time that can be easily installed in small and medium rivers and predict when the river water will reach the flood level more than two hours in advance so that flood risk information can be provided for residents living near small and medium rivers to start evacuation early. To this end, the RRI model was adopted as the runoff analysis model for this system. The RRI model can represent runoff phenomena such as surface runoff and intermediate runoff with fewer parameters to be adjusted. With this model, water level forecasting can be performed using JMA's radar-raingauge analyzed precipitation and short-time precipitation forecasts delivered in real time. In addition, the SCE-UA method was applied to the RRI model as an automatic parameter adjustment function to accurately and quickly represent a rainfall-runoff mechanism that changes from time to time. A particle filter was also adopted to sequentially modify the water level prediction model using real-time water level observation data.

ICHARM’s main achievements for FY2020 and FY2021 are as follows. We investigated the accuracy of various rainfall products and proposed methods for appropriately combining multiple products. The rainfall products included JMA's radar-raingauge analyzed precipitation, short-time precipitation forecasts, a preliminary version of radar-raingauge analyzed precipitation, a preliminary version of short-time precipitation forecasts, and MILT’s high-resolution precipitation nowcasts. In addition, a prototype of a real-time automatic calculation, representation, and distribution system was developed, and the models of approximately 130 rivers constructed by FY2021 were applied to the system. Information distribution experiments are currently underway. In addition, a standard model, which will serve as the basic method for model construction, is being developed to create a manual on model construction methods for nationwide deployment. Optional settings are also prepared for river characteristics that cannot be covered by the standard model. This research and system development were conducted under the PRISM of the Council for Science, Technology and Innovation, Cabinet Office, Government of Japan.



Predicting the flood level two hours in advance

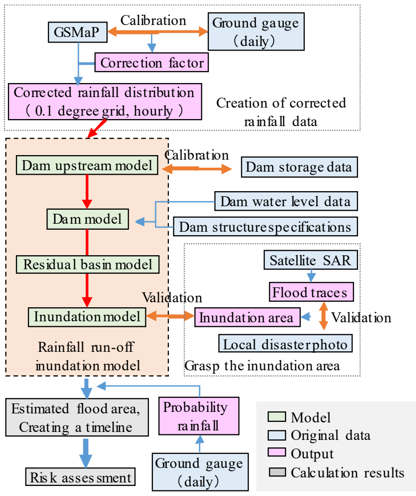


Real-time automatic calculation, representation, and distribution system

2.3 Myanmar-Agriculture development support project: Technical support in flood simulation for downstream areas of the Swa Chaung Dam

In August 2018, a spillway concrete weir of the Swa Chaung Dam, located about 60 km south of Naypyidaw, the capital of Myanmar, failed and caused large-scale flooding downstream, which damaged more than 80 villages and forced more than 60,000 people to evacuate and be displaced.

Among many other countries where many irrigation dams have been constructed to use rainy season water for dry season agriculture, Myanmar has been exposed to such flood risk, which has become greater in recent years, as heavy rainfall has been even more intense because typhoons have become increasingly larger due to global warming. For this reason, it is urgent to predict possible flood events in case of a dam failure and prepare emergency response measures in advance.

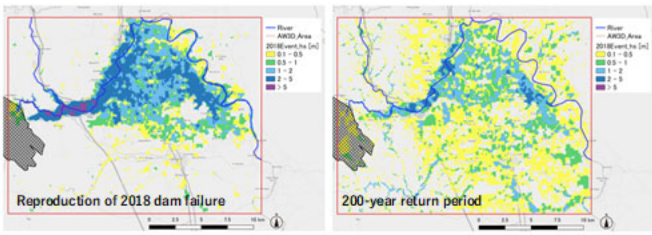


Flow chart of analysis

On the other hand, the flood simulation results in the lower reaches of the Swa Chaung Dam submitted to the World Bank by a consultant company of a certain country were questioned for their reliability; clearly, they were not reproduced well when compared with local disaster photographs.

In addition, we thought that it would be effective to utilize satellite data in order to grasp the inundation area over a wide area, which can, in turn, be used to verify simulated inundation area.

Since accumulating abundant research experience using satellite data in terms of inundation area estimation, rainfall distribution, and rainfall run-off inundation models, ICHARM made a proposal to the World Bank about technical support using these technologies. As a result, the World Bank decided that ICHARM provide technical support to simulate the flooding in the downstream area at the time of the Swa Chaung Dam failure.



Examples of flood simulation

The first figure shows the building, calibrating, and verifying processes of the inundation model and future risk analysis carried out in this study. Of these processes, the correction of GSMaP using ground rain gauge data and the estimation of the inundation area using the polarization information of satellite SAR data are described in 3.2.3. We confirmed that our model was able to reproduce dam failure flooding very well. Risk assessment was performed using this model by simulating events of different scales, such as 1/200, 1/1000, and probable maximum rainfall. The resulting information was provided for local experts to plan disaster prevention measures and crisis management downstream of the dam. A manual was also created to describe these series of methods for their application to other areas with dams.

Since the satellite products used in the proposed method are available free of charge anywhere in the world and easy to handle, this method is a general-purpose method that can be widely applied to the evaluation of flood disasters, which frequently occur in various parts of the world.

2.4 Publication and dissemination of Collection of Critical Situation during Flood Emergency Response

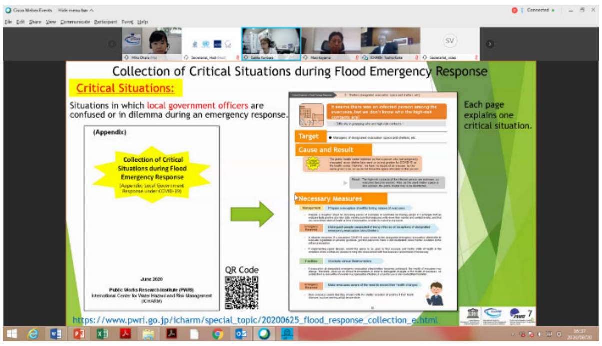
ICHARM has posted “Collection of Critical Situations during Flood Emergency Response” on its website since June 2020, aiming to help improve the emergency response capacities of local governments for more effective management of flood disasters, which frequently occur across Japan in recent years.

Defining critical situations in which local government officers have a hard time making sensible decisions because they panic, don’t know what to do, are confused or in dilemma, etc., during an emergency response effort, we collected typical critical situations from the review reports of past flood disasters and summarized as a booklet. Also provided with the booklet is the “Appendix for local government response under COVID-19,” which lists possible critical situations and necessary countermeasures during flood emergency response under COVID-19.

（https://www.pwri.go.jp/icharm/special_topic/20200625_flood_response_collection_j.html）

From the start of publication in June 2020 to the end of September 2021, the Japanese version of the booklet was accessed 6,669 times, and the English version was accessed 1,261 times. We advertised these on various occasions, and on August 20, 2020, “The International Online Conference To Address Water-related Disaster Risk Reduction (DRR) under the COVID-19 Pandemic” hosted by HELP and others, introduced these booklets to a worldwide audience. The plenary session was watched by about 300 people from 40 countries, including their Majesties the Emperor and Empress of Japan.

Furthermore, in response to requests from local governments, ICHARM has delivered lectures and training on these booklets. On July 7, 2021, we gave a lecture to the mayors and disaster prevention staff of local governments at a council that discusses disaster mitigation measures for large-scale floods in the lower Natori River and the lower Abukuma River in the Tohoku region. On October 6, 2021, in Toyota City, Aichi Prefecture, training was held for city officials to learn cases addressed in the Collection of Critical Situation during Flood Emergency Response according to a timeline. We received the 2021 Excellence Award for our efforts from the Research Group for National Land and Infrastructure Technology of the Ministry of Land, Infrastructure, Transport and Tourism. We will continue to update the booklets and develop dissemination activities.



Presentation at an international online conference

Training in Toyota City

2.5 HyDEPP-SATREPS Philippines

ICHARM represents the Japanese side of the joint research project named "The Project for Development of a Hybrid Water-Related Disaster Risk Assessment Technology for Sustainable Local Economic Development Policy under Climate Change in the Republic of the Philippines (HyDEPP-SATREPS)" based on SATREPS. As an implementing agency, ICHARM is engaged in various activities with joint research institutes in Japan and the Philippines.

The joint research project started as a JST project in Japan on April 1, 2020, but the start of the JICA project in the Philippines was postponed due to COVID-19. The activities of the five-year project in the Philippines finally started on June 3, 2021.

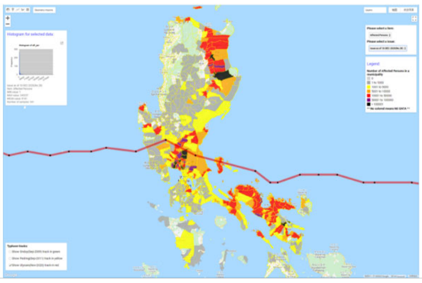
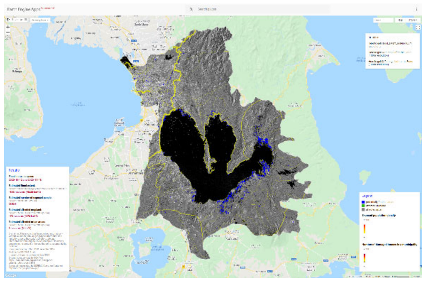
The joint research institutes in Japan are the University of Tokyo, Tohoku University, University of Shiga Prefecture, Nagoya University, and Kyoto University.

The representative research institute on the Philippine side is the University of the Philippines Los Banos, the joint research institutes are the University of the Philippines Diliman and Mindanao, and the collaborative institutions are the Department of Science and Technology (DOST), the Department of Public Works and Highways (DPWH), and the Metropolitan Manila Development Authority (MMDA), and Laguna Lake Development Authority (LLDA).

The joint research project finally started after a long disruption. A kick-off meeting was held online on June 30, 2021, and a Joint Coordinating Committee (JCC) was held online with the participating organizations of both countries on November 17, 2021. In July-August 2021, an e-learning program on a water disaster risk assessment method was conducted. A total of 83 people participated, and 49 people submitted assignments and completed the program.

On November 12, 2020, a giant typhoon, Ulysses, crossed Luzon Island amid the preparation for starting a local project. Severe damage resulted in the Pampanga River basin, the Pasig Marikina River basin, and the Laguna basin in the research area of Luzon Island. On November 5, 2021, which marked the first year since the disaster, a public webinar was held with 243 participants to share the results of the research project. In the webinar, ICHARM introduced an online system that comprehensively visualizes a damage situation using Google Earth Engine by incorporating the inundation area read from satellite images and the damage status of each municipality collected from damage reports.

Although restrictions on overseas travel may continue for a while due to COVID-19, we plan to continue joint research in the future.

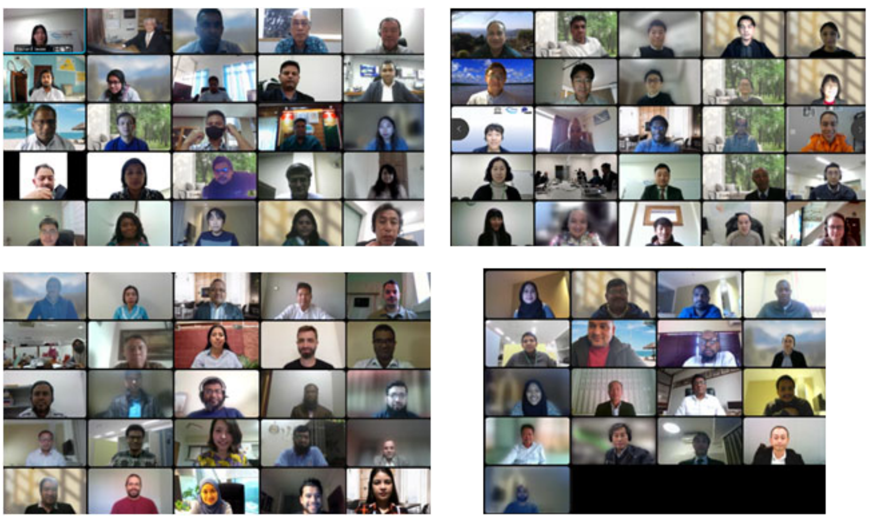



Displaying damage caused by Typhoon Ulysses on Google Earth Engine (Left: Distribution of affected population by municipality as of December 10, 2020, Right: Estimated inundation area by SAR images in the Pasig-Marikina River and Laguna Lake basin)

2.6 Online follow-up seminar for all the graduate of the ICHARM master's and Ph.D. Programs

One and a half years after the establishment, ICHARM launched the Disaster Management Policy Program (master's program) in October 2007. Three years later, in October 2010, the Disaster Management Doctoral Program started. As of September 2021, 157 students completed the master's program, and 15 students the Ph.D. program. They are active as leaders in water-related disaster risk reduction at their workplaces and communities in 37 countries, mainly in Asia, Africa, and Latin America. On February 25, 2022, a follow-up seminar was held online, inviting all graduates. Over 100 participants were present, including 80 graduates and ICHARM staff involved in the educational programs. The seminar consisted of three special lectures, two sessions of Focus Group Discussion, and General Sharing to share the discussion results with all participants. The first lecture was given by the director of the WMO. The lecture included facts about climate and water and analyses conducted by the WMO. He also expressed high expectations for ICHARM students, graduates and researchers for future contributions. The director of the Ministry of Public Works and Housing, Indonesia, spoke about a unique framework called the Super Specialist Program in Indonesia. ICHARM Executive Director talked about how difficult yet how critical it is to take bold, transformative steps to achieve a sustainable society by enhancing disaster resilience, with concrete recommendations for action.

In the first session of Focus Group Discussion, the participants were divided into six groups for different topics of climate change, hydrological processes, flood inundation, sediment and river channel change, and disaster risk and response. In each group, the members shared their issues and discussed possible solutions. In the second session, six new groups were formed with different members and discussed how the graduates of ICHARM's educational programs should keep in touch and cooperate and what should be done to make the programs more attractive. The participants agreed that opportunities like follow-up seminars are very important to strengthen cooperation among the graduates and improve each other's skills. They acknowledged that follow-up seminars are extremely effective, and many requested that they continue to be held once a year. Many valuable suggestions were voiced for making ICHARM's programs more attractive, though some are fairly easy to realize while others may take a while. Requests such as setting up a technical consultation window at ICHARM can be achieved relatively easily, but ones such as chaining admission requirements may not be achieved in the short term. The follow-up seminar was held online for the first time but turned out to be very meaningful.

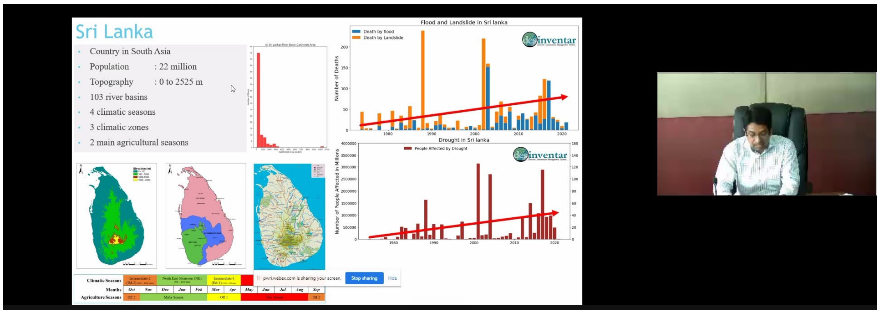


2.7 Support for the promotion of IFI activities and the autonomous participation by graduates from ICHARM training programs

IFI is a worldwide framework to promote collaboration in flood management among international organizations such as UNESCO, WMO and UNDRR. ICHARM has been its secretariat since its establishment. Under the framework of IFI, ICHARM has played the role of a facilitator to promote the establishment of Platforms on Water Resilience and Disasters in cooperation with relevant organizations in the Philippines, Sri Lanka, and Indonesia. Since the spring of 2020, ICHARM has faced difficulties in taking business trips abroad or holding in-person conferences due to the COVID-19 pandemic. However, ICHARM has organized e-learning sessions and related online workshop programs, in which the relevant organizations to the IFI Platform participated. These programs have been kept underway to support countries in developing the OSS-SR and fostering facilitators. In addition, the AWCI sessions were convened online on February 26, 2021, and on October 29, 2021, as sectional meetings of the AOGEO, where each country reported on the activities, implementation status, and future plans.

Regarding these IFI Platform activities, graduates from ICHARM training programs have come to play significant roles. For instance, Sri Lanka’s Platform has had meetings four times since the unprecedented flood disaster in May 2017. For all the meetings from the first one, a graduate of the ICHARM master course program in 2009-2010, who is also an engineer of the Irrigation Department, one of the major organizations in the Platform, has played a central role in all the processes, including preparatory and operational tasks. At the AWCI session in October 2021, another graduate of the ICHARM doctoral program in 2018-2021, who is back in Sri Lanka and restarted his work at the Irrigation Department, provided an activity report representing the department. The latter one obtained a Ph.D. for the research on water-related disaster risk reduction and integrated water resources management under the climate change targeting in the Mahaweli River basin in Sri Lanka. They are expected to play a leading role in their country by utilizing the experiences of research and development at ICHARM.

In this way, ICHARM will continue to support the graduates from ICHARM training programs in participating in and contributing to establishing an IFI Platform in each country and other activities.



The graduate of ICHARM doctoral program gave a presentation representing the Irrigation Department of Sri Lanka at the AWCI session of the 14th AOGEO (October 29, 2021)

３． Research

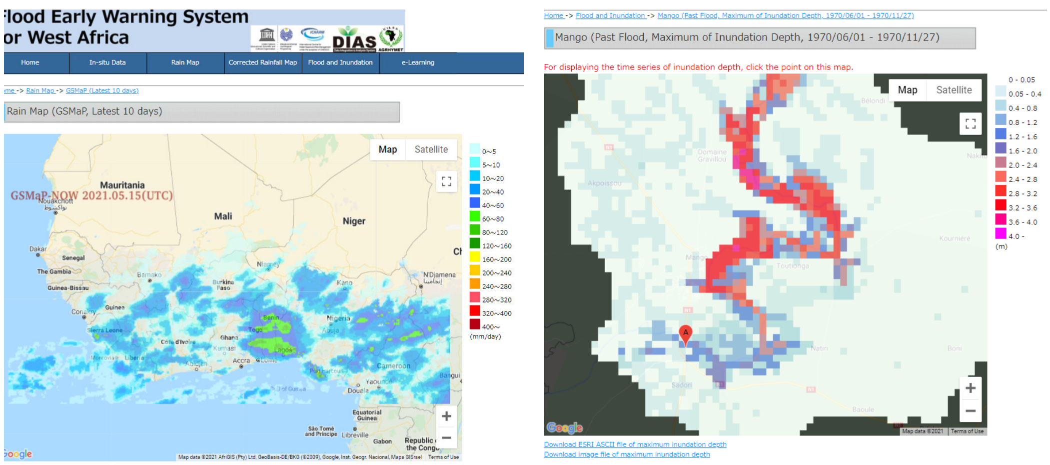
3.1 Water-related disaster data archiving, sharing and statistics

3.1.1 Development of the Flood Early Warning System for West Africa

In recent years, floods have been frequent in West African countries, causing human damage and impeding economic development. ICHARM developed the FEWS for the Niger and Volta River basins on the DIAS in collaboration with the University of Tokyo’s EDITORIA as part of the WADiRE-Africa project, which is a technical support research project to assist West African countries in avoiding and mitigating flood damage.

FEWS primarily provides three types of information, updating them every hour. One is real-time GSMaP rainfall distribution. Another is basin-scale rainfall distribution using GSMaP that is bias-corrected using in-situ rainfall data. The last one is river water levels and inundation area over a basin and at high flood risk locations (hot spots), which are obtained from the WEB-RRI using bias-corrected GSMaP as inputs. FEWS also provides expected maximum inundation depths at hot spots. GSMaP-based rainfall distribution tends to be larger than the actual distribution in semi-arid regions such as West Africa, but this problem was solved by performing bias correction on GSMaP as mentioned above.

FEWS and simulation results have been made available for 11 countries in the Niger and Volta River basins, the AGRHYMET, the NBA, the VBA, and other related organizations.

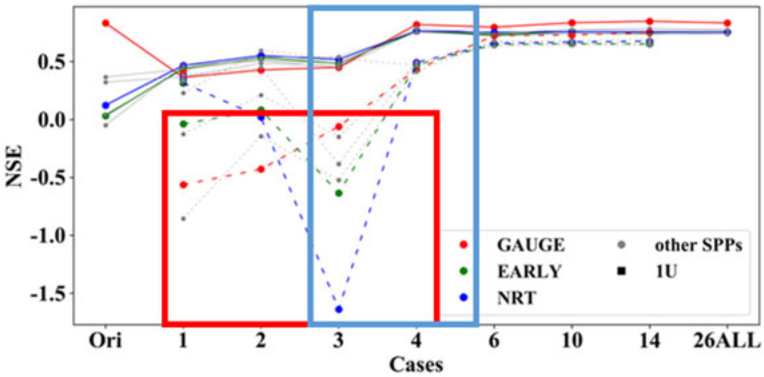


GSMaP real-time visualization (left) and expected maximum inundation depths at hot spots (right) on the FEWS

3.1.2 Utilization of Satellite Precipitation Products in Data Insufficient Areas

To investigate the optimal density and placement pattern of ground rain gauges for bias correction, this study conducted 346 runoff analyses in the Fuji River basin by applying 17 rain gauge placement patterns and 4 correction methods to 6 kinds of satellite precipitation products. The results showed that the optimal method for the target basin is the statistical and dynamical bias correction (SDBC) method, in which correction factors estimated from precipitation data of the past ten days are further bias-corrected using correction factors estimated from long-term precipitation data.

The study also showed that a certain number of ground rain gauges in a basin can ensure accurate runoff analysis in the case of correcting real-time satellite rainfall products. The figure shows the relationship between the number of ground rain gauges used for bias correction (horizontal axis) and the estimation accuracy of the hydrologic model with bias-corrected satellite rainfall products (the vertical axis is Nash coefficient, or NSE; the larger the value, the better). In the figure, the green line indicates the "EARLY" product, the early delivery version of the IMERG precipitation product, and the blue line indicates the "NRT" product, the early delivery version of the GSMaP satellite precipitation product. Considering that these products are applied to the target basin in real time, rain gauges at as few as four locations can ensure a reasonably high degree of accuracy, even if they are arranged eccentrically.

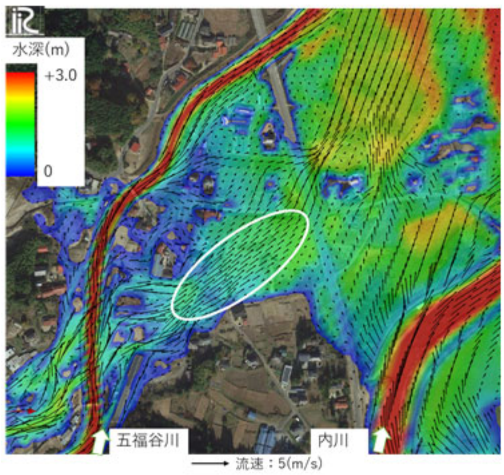


The relationship between the hydrologic model's estimation accuracy (vertical axis, Nash coefficient) and the number of ground rain gauge locations used for bias correction (horizontal axis). The solid and dashed lines indicate the reference cases of uniform or biased ground rain gauge locations, respectively. "GAUGE," "EARLY," and "NRT" mean the simulation uses only rain gauges, early provided data by IMERG, and early provided data by GSMaP, respectively. "Other SPPs" means using other satellite precipitation products, and "1U" means using only one upstream rain gauge.

3.2 Risk assessment on water-related disasters

3.2.1 Development of models to reproduce and predict flood inundation with sediment

As seen in the Gofukuya River disaster in the East Japan heavy rains of 2019, landslides and debris flows in mountainous areas during heavy rains can result in large amounts of sediment production, which causes significant damage to the downstream areas. With the frequent occurrence of this type of disaster, there is a need for methods to properly assess the risk of flood inundation with a huge amount of sediment. To this end, we applied the RRI model developed by ICHARM for rainfall-runoff and one-dimensional flow analysis after modifying it so that the confluence points of river channels can be treated as a unit channel. We proposed this



The results of flood flow computation in the Gofukuya River (The color counters show flow depths at the peak discharge.)

method to easily analyze sediment discharge from the basin. The model was applied to calculate the sediment discharge from the Gofukuya River basin, and then 2D analysis was conducted to reproduce the flood flow with sediment in the Gofukuya River using the calculation results as the boundary condition. The results showed that this approach can reproduce sediment deposition thickness and grain size distribution with a certain degree of accuracy.

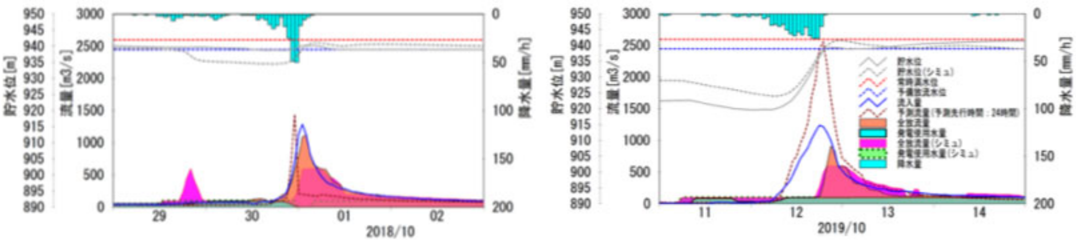
An integrated model was developed to set the upper boundary condition of an inundation area by coupling real-time flood forecasting, which uses the above-mentioned RRI model with a particle filter, with basin sediment runoff analysis. Then, a system was developed to predict the behavior of flood, sediment, and flood inundation in real time on DIAS by applying the calculated upper boundary condition to a 2D analysis model using iRIC-Nays2DH A. Real-time calculations were conducted for the Kagetsu River using this system. The system makes it possible to calculate the sediment discharge from the basin, estimate its impact on local flows in real time, and use this information for evacuation forecasting and warning.

3.2.2 Development of optimized dam operation based on dam inflow prediction

In this research, ICHARM developed a WEB-DHM-S for the Oi and Sai Rivers in Japan. We then conducted ensemble dam inflow prediction using this model and used the prediction results to optimize dam operation to reduce flood risk and increase hydropower generation.

In the case of the Sai River, WEB-DHM-S predicted the flood discharge (800m3/s) at Ikusaka Dam caused by a typhoon in 2018 with lead times of 7 to 31 hours.

In the Oi River, the optimized dam operation with pre-releases of dam water was applied to Hatanagi Daiichi Dam during flooding caused by typhoons in 2018 and 2019. In the 2018 event (left figure), pre-releases were performed on the morning of the 29th (pink range). As a result, the simulated dam water level (gray dotted line) decreased, and the simulated peak flow (pink range) was successfully controlled to remain below the 600 m3/s level when the inflow (solid blue line) peaked. If the pre-releases had not been performed, the gate discharge rate would have exceeded 600m3/s, as shown in the orange range. The 2019 event (right figure) is a typical case in which the dam water level was low at the forecasting start time. The inflow was stored effectively up to the full water level (red dotted line) in advance, and the gate discharge was successfully controlled to remain below 600 m3/s. According to the Power Generation Volume Index, the average power



Results of dam operation during the flood caused by a typhoon at Hatanagi Daiiti Dam
(left: September 30 to October 1, 2018, right: October 12-13, 2019)

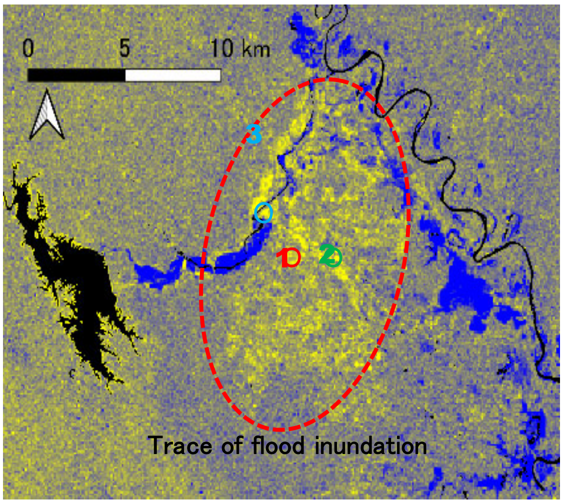
generation during the warm season (July to October) showed a 12.8% increase in 2018 and a 3.7% increase in 2019.

As described above, with such seamless dam inflow prediction from low flow to peak flow, it is possible to operate the dam to increase hydropower generation and decrease flood risk at the same time.

3.2.3 Estimation of rainfall and inundation area using satellite data

In recent years, floods have become more frequent in many parts of the world due to increasingly frequent heavy rainfall events caused by global warming. Therefore, it is necessary to assess flood risks accurately and take appropriate measures to mitigate flood damage. However, many regions lack the hydrological data required for simulation model building. In particular, it was a challenge to determine hourly precipitation distribution, which is the driving data for models, and past inundation area to verify the reproducibility of inundation models.

Therefore, in order to reproduce inundation caused by an earth-dam failure in Myanmar in 2018, daily rainfall data from three nearby locations were used to create precipitation data with an increased spatiotemporal resolution by correcting GSMaP and applying it to a runoff inundation model. Satellite imagery is often used today to identify inundation areas. Still, it is not easy to capture the peak flooding period because satellite observations are at regular intervals and are affected by cloud cover. In this study, changes in the surface conditions of vegetation due to floodwaters were identified by comparing pre- and post-flood SAR images. These were considered traces of floodwaters. The area was then assumed to be the inundation area, and the results were applied to validate the inundation model.



Change in VH polarization from Sentinel-1 SAR images before and after the flood. Yellow indicates an increase, and blue indicates a decrease. Black is the water surface before the flood. The yellow area is assumed to be a trace of the flood inundation area because it is thought to capture changes in surface conditions such as rice being pushed over by turbid water.

3.3 Monitoring and forecasting water-related disaster risk changes

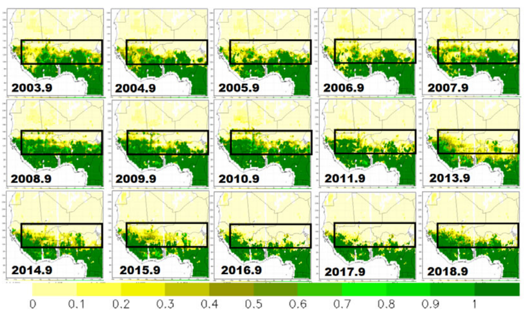
3.3.1 Estimate of future water hazard risk (flood and drought) by climate change in the Solo River basin and the Davao River basin

ICHARM has participated in the "Hazard assessment in Asian and Pacific countries and international cooperation," one of the subprograms of the area theme D, "integrated hazard prediction," in the TOUGOU program, supported by the Ministry of Education, Culture, Sports, Science and Technology, Japan, starting from October 2017.

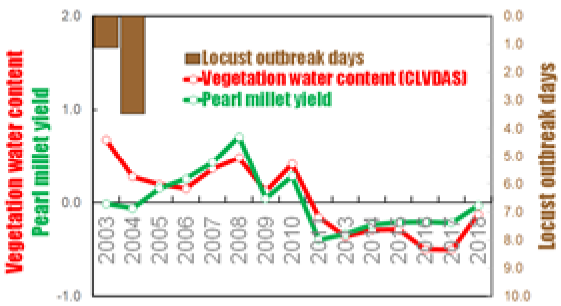
In the TOUGOU program, we investigated changes in precipitation, flood discharge, inundation, and water resources due to global warming in the Solo River basin, Indonesia, and the Davao River basin, Philippines. We dynamically downscaled the MRI-AGCM 3.2S and 3.2H models for past and future climate scenarios of RCP8.5 and PCP2.6 using a regional climate model (WRF model) to obtain precipitation, temperature, and other variables in 5 km grids. In the Solo River basin, precipitation is likely to increase over the basin under the RCP8.5 scenario compared to the past climate. On the other hand, under the RCP2.6 scenario, precipitation is likely to increase in the downstream area (northern part) but likely to decrease in the upstream area (southern part) compared to the past climate. In the RCP2.6 scenario, an anti-cyclone in the southern Indian Ocean is projected to be intense, strengthening easterly winds around Java Island. The strengthened easterly winds may cause a decrease in rainfall in the upstream river basin, whose eastern side is surrounded by high mountains.

3.3.2 Development of a drought monitoring system over West Africa using the CLVDAS

In West Africa, droughts are causing significant damage to health and the economy. In this study, ICHARM investigated agricultural droughts in West Africa during the period from 2003 to 2018 using the CLVDAS, which integrates passive microwave remote sensing techniques, a land surface model, a dynamic vegetation model, and a data assimilation scheme. Although CLVDAS simulates soil moisture, evapotranspiration, LAI, and vegetation water content, grains generally store water in their body after absorbing it from their roots to grow and bear fruit. Therefore, this study focused on vegetation water content (m^3/m^3) as a drought indicator. In West Africa, the rain-fed agriculture of crops for home consumption is thriving. Because pearl millet is the main staple crop in this region, the pearl millet yield (t) from FAOSTAT was selected as another drought indicator. However, it is not possible to compare vegetation water content and pearl millet yield quantitatively; thus, the normalized index based on the z-score theory was calculated for each day from 2003 to 2018 and compared. The results found a good agreement between the pearl millet yield and the simulated vegetation water content from CLVDAS in the period from 2005 to 2018 and concluded that CLVDAS can assess drought in West Africa. Furthermore, both drought indicators clearly indicated the drought trends after 2011. We also found that one of the causes of the discrepancy between the



Vegetation water content (m^3/m^3) in West Africa: □ indicates the Sahel-inland region.



Comparison of the normalized index for vegetation water content, pearl millet, and locust outbreak days in the Sahel-inland region.

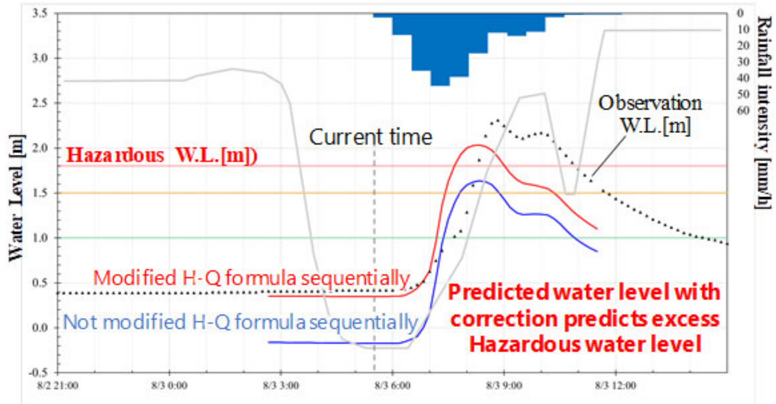
vegetation water content and the pearl millet yield in the period from 2003 to 2004 may have been attributable to the effect of locust plague (FAO Locust watch).

3.4 Support through proposal, evaluation and application of policies for water disaster risk reduction

3.4.1 Examination of methods for improving the prediction accuracy of water level prediction systems in small and medium rivers

ICHARM is working on the development of a water level forecasting system that is efficient in calculation time, cost, and mechanism and meets the level of accuracy required. The system is also expected to be easily installed in small and medium rivers.

In the development process, we found some cases where conventional H-Q curves did not fit with the actual river conditions because the riverbed had changed. Therefore, we incorporated an algorithm that sequentially corrects an H-Q curve into the system's particle filter. This improvement made it possible to conduct real-time water level forecasting while coping with riverbed variation.



Comparison example of predicted water level with and without H-Q curve sequential correction

In addition, since it takes time and effort to estimate the parameters that significantly affect the reproducibility of simulation models, the SCE-UA method was applied to the RRI model used in this system to automatically adjust the parameters. Moreover, since the current version of the method is targeted only at mountainous areas, it was improved to optimize the parameters for cropland and paddy fields in order to increase its applicability to river basins whose dominat land use is cropland and paddy fields. As a result, the system as a whole became highly applicable.

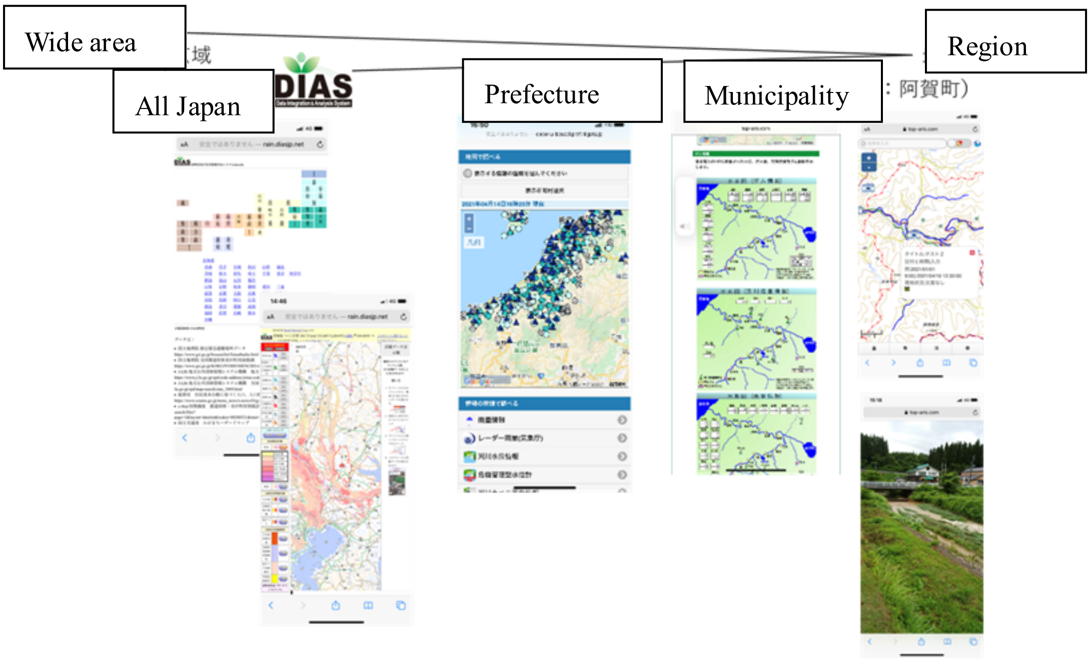
3.5 Support for improving the capacity to practice disaster prevention and mitigation

3.5.1 Research on flood risk assessment for river basins in mountains and information sharing

ICHARM analyzed the flood risk assessment tools used in Aga Town, Niigata Prefecture, and Iwaizumi Town, Iwate Prefecture, in Japan and made improvements to incorporate them in IDRIS. We developed the basic technology to link IDRIS with real-time water level prediction in small and medium rivers in the future by installing IDRIS on DIAS.

ICHARM also promoted cooperation among municipal disaster prevention personnel and improved IDRIS into a system that helps share information on disaster prevention and mitigation among collaborating local governments (Aga Town of Niigata Prefecture, Iwaizumi Town of Iwate

Prefecture, and Tsuruoka City of Yamagata Prefecture) on smartphones.

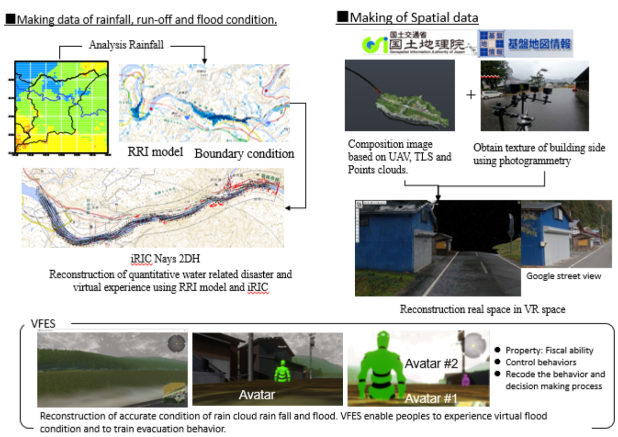


IDRIS on DIAS and IDRIS screen for smartphones

3.5.2 Development of a risk communication system for raising awareness of water disaster and crisis management

ICHARM reproduced an inundation situation for Aga Town, Niigata Prefecture, by acquiring spatial information using UAV, ground laser survey, photogrammetry, the RRI model, and a flood inundation simulation model (iRIC Nays2D). We then developed a virtual flood experience system that allows users to experience evacuation during a virtual flood using an avatar. We also conducted a technical study to seamlessly read the XML data placed on DIAS.

Using the virtual flood experience system, we performed a reality assessment of the water disaster situation of Typhoon No. 19 in 2019 with support from affected residents. We discovered that when making decisions about evacuation, the residents decided how to act based on their past flood experiences (e.g., 2011 Niigata, Fukushima heavy rain). This result points out that it is critical for people to know that experience can work against them, especially considering climate change.



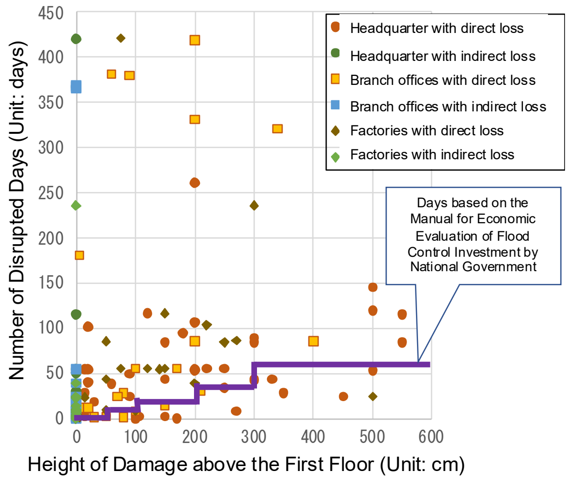
Development of Virtual Flood Experience System

For this reason, we created a VR tool for passing on lessons people should learn from past flood events, including the lesson that it is sometimes wise not to rely too much on experience.

3.5.3 Study on globally-applicable multiple-risk assessment of water-related disasters and on a method of building a resilient society based on assessment results

ICHARM has been exploring advanced methods to accurately estimate disaster risks that have not been evaluated by conventional methods. In one attempt, we conducted a questionnaire survey for businesses and analyzed the impact of a disaster on their production and sales in the cases of Joso City, Ibaraki Prefecture, damaged by the Kanto and Tohoku heavy rain in 2015, and Hiroshima and Okayama Prefectures, affected by the heavy rain disaster in July 2018. The results revealed the relationship between the presence or absence of direct and indirect damage and the days of business suspension.

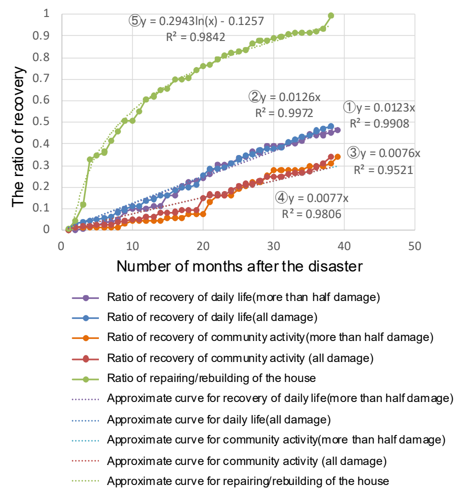
The results of this research prompted the revision of the Flood Damage Economical Survey Manual in 2020.



Relationship between the floodwater level above first floor and the days of business suspension due to the July 2018 heavy rain

3.5.4 Proposal of risk indicators to comprehensively evaluate the disaster mitigation effects of various disaster prevention measures and investments

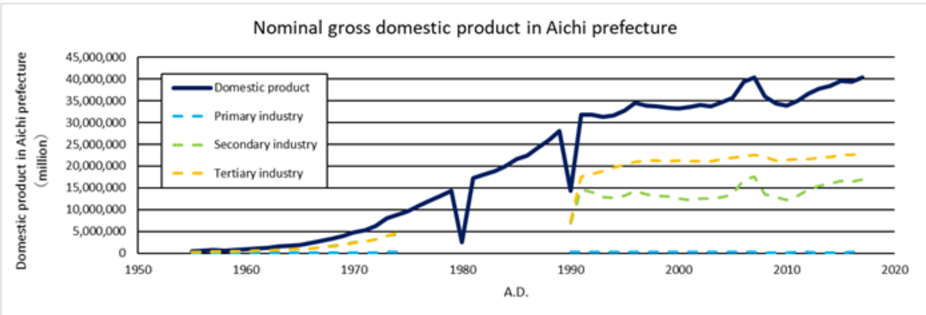
For communities to be disaster- resilient, they should be able to reduce as much damage as possible and recover as fast as possible. Because communities' ability to recover has not been studied much, we conducted a questionnaire survey to find out the recovery curves of housing reconstruction, daily life, and community activity in the two affected areas: Joso City, Ibaraki Prefecture, damaged by the Tohoku and Kanto heavy rain disaster in 2015, and Iwaizumi Town, Iwate Prefecture, damaged by Typhoon No. 10 in 2016. Based on the survey results, we proposed indicators, such as the period that the communities may need to



Examples of recovery curves and indicators for the recovery of regional functions in Iwaizumi Town achieve a 50% recovery, as the targets for planning and investing in disaster risk reduction measures. We also proposed possible recovery promotion measures, for example, to shorten this 50% recovery period.

3.5.5 Research on a simple method to estimate socio-economic impacts of flood disasters

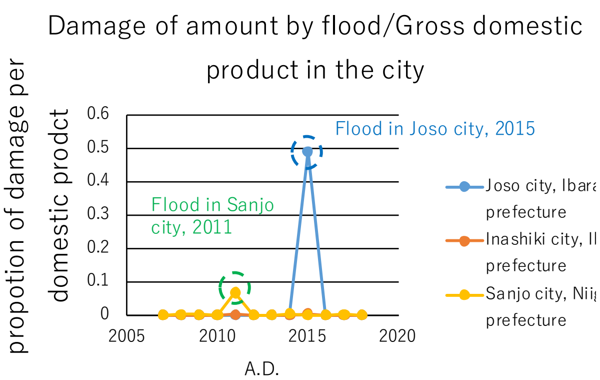
ICHARM has been studying a simple method to estimate the impact of flood damage on socio-economic activities. In this process, we analyzed the gross prefectural product (nominal) from 1955 to 2018 by industry for prefectures that suffered severe flood damage in the recent past to understand the impact of flood damage on socio-economic activities. The results found that the gross prefectural product was greatly impacted by nationwide crises such as oil shocks but not by flood damage.



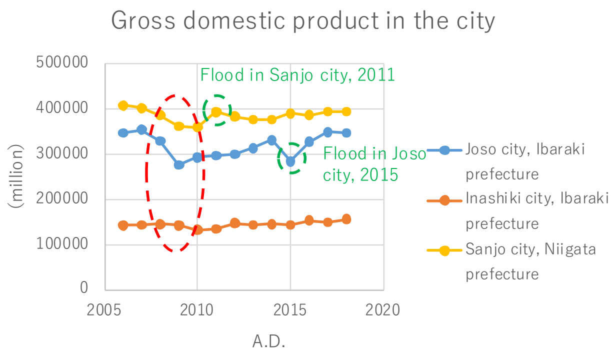
Major events in Japan
Tokyo Olympics(1964)
Izanagi boom (1965 - 1970)
First oil shock (1973)
Second oil shock (1979-1980)
Recession caused by the strong yen (1986)
Start of VAT (1989)
End of the bubble economy (1991 - 1993)
Great Hanshin-Awaji Earthquake (1995)
2008 financial crisis (2008)
Great East Japan earthquake (2011)
Start of Abenomics (2012)

Changes in Aichi Prefecture's gross domestic product

We also analyzed the gross municipal product for the three municipalities: Joso City, Ibaraki Prefecture, severely damaged by the Kinugawa River levee breach in 2015; Inashiki City, Ibaraki Prefecture, whose gross product is similar to that of its neighboring Joso City; and Sanjo City, Niigata Prefecture, damaged by a flood in 2011. The results suggested that if the flood damage reaches as large as 50% of a municipality's gross product, it would cause a great impact on its gross product.

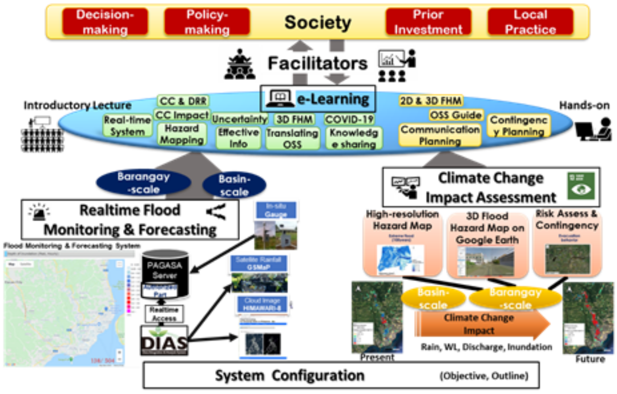


Flood damage/Gross municipal product



Gross municipal product
(based on the year of disaster)

3.5.6 Development of an "Online Synthesis System for Sustainability and Resilience (OSS-SR)" and Fostering "Facilitators" in Davao City, Philippines

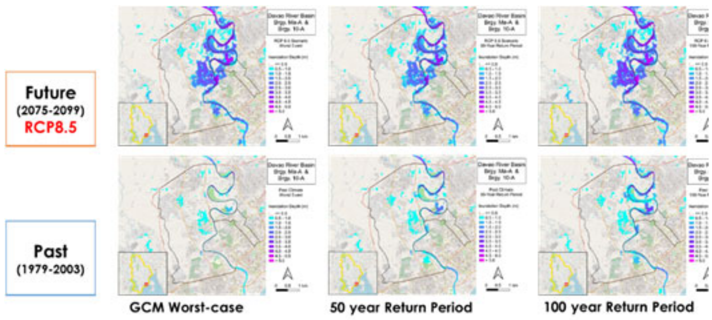


Concept of OSS-SR

ICHARM has developed an "Online Synthesis System for Sustainability and Resilience (OSS-SR)" on Data Integration Analysis System (DIAS) and has helped foster "Facilitators" by utilizing OSS-SR for e-learning as one of the activities organized by the Platform on Water Resilience and Disasters in the Philippines. The OSS-SR for Davao City is designed to integrate knowledge and information on real-time flood forecasting and climate change impact assessment and allow local stakeholders to learn about them through e-learning. Furthermore, we held an e-learning workshop for about a month from April 19 to May 17, 2021, and hands-on training for two weeks from January 17 to 28, 2022, to effectively foster "Facilitators" for Davao City in cooperation with the Department of Science and Technology Region 11 (DOST XI).

Especially in the hands-on training, participants took four lectures and practiced flood hazard mapping, contingency planning, and action planning based on the lecture contents. They were highly interested in the training and submitted useful deliverables, as they learned the flood risks at the locations of important structures, schools, and evacuation centers using the results of climate change impact assessments and data collected from the flood forecasting system in Davao City. Their achievements should be utilized to formulate practical disaster prevention plans and measures.

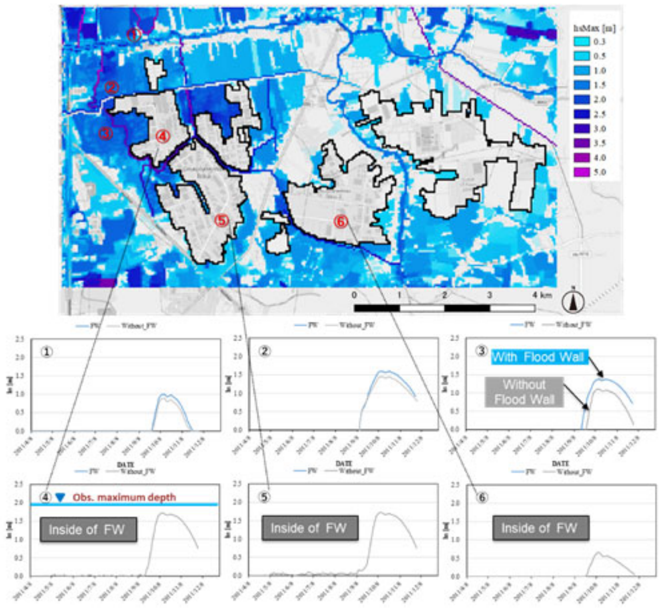
Through a series of workshops and training, we were able to have meaningful discussions while getting a lot of feedback from participants on various issues, such as the usability of the integrated knowledge system, local operation and sustainability of the system in the future, cooperation with related projects, the reflection of local knowledge, experience, and insights in projects, and effective communication to the target audience (e.g., policymakers, disaster management teams, private sectors, the media, and civil groups). Based on the above, we would like to enhance the disaster resilience of local



Comparison of inundation conditions with and without climate change impact communities by further improving the OSS-SR and implementing practical training through co-design with local stakeholders.

3.5.7 STREPS project "Regional Resilience Enhancement through Establishment of Area-BCM at Industry Complexes in Thailand"

ICHARM aims to contribute to the development of a sustainable society and economy in Thailand by strengthening local resilience through the formulation of Area Business Continuity Management in its industrial clusters, with participation in the JICA-JST SATREPS project, "Regional Resilience Enhancement through Establishment of Area-BCM at Industry Complexes in Thailand." We also aim to extend the achievements of the project to other ASEAN countries. Specifically, we have been developing methods that assist decision-makers in making decisions about the operation and evacuation of businesses by forecasting when inundation may start and end, which area may be inundated, and how deep the inundation may be by using a hydrological basin-scale model and an industrial park-scale high-resolution model.



Inundation analysis results in the target industrial zone

４． Training

4.1 Master's program: Water-related Risk Management Course of Disaster Management Policy Program

Since 2007, ICHARM has provided a one-year master's program, "Water-related Risk Management Course of Disaster Management Policy Program (JICA Training Program: Training for Expert on Flood-Related Disaster Mitigation)," as a joint effort with JICA and GRIPS. This program is targeted at officials of administrative organizations and designed for them to obtain a master's degree within a single year. In the first half of the course, from October to March, the classes consist mostly of lectures; in the second half, from April to the end, students work on research and graduation theses. In addition, several study trips are conducted during the program for students to visit dam, river, and other management offices around Japan, where they can learn firsthand knowledge and experience in current flood management in Japan from experts of MLIT and other organizations.

Between 2007 and 2020, the master's program of ICHARM graduated 150 students from 34 countries.

In September 2020, the 13th batch of 11 students from 6 countries (Bangladesh, Bhutan, Brazil, Myanmar, Nepal, Pakistan), who entered the program in October 2019, graduated with a master's degree. In the following month, the 14th batch of 7 students from 6 countries (Bangladesh, Bhutan, Malaysia, Mauritius, Myanmar, Tonga) entered the program.

In September 2021, the 14th batch of 7 students from 6 countries graduated, and in the following month, the 15th batch of 11 students entered the program from 8 countries (Bangladesh, Bhutan, Indonesia, Malawi, Malaysia, Nepal, the Philippines, Sri Lanka).

Online lecture using an electronic blackboard

Hydraulic model experiment (Verifying what the student learned in the hydraulics class in the experimental waterway)

At the beginning of the course, all seven students who enrolled in October 2020 could not enter Japan due to the spread of COVID-19. Therefore, ICHARM introduced an electronic blackboard before the classes started and established a system to provide lectures online in real time to students staying in their home countries.

Also, in the first half of the course, some students could not enter Japan and thus had no access to paper-based training materials. ICHARM decided to provide them in digital form before the lectures. Also, all the lectures were recorded as a solution to internet communication problems.

In addition, ICHARM developed e-learning materials to facilitate self-study. Various efforts were made to keep the programs in session. We asked outside lecturers to give lectures online if they had to commute through high coronavirus risk areas. As described above, the lectures and training were conducted in different styles according to the severity of the COVID-19 spread; some lectures were given in person, some remote, and still some a combination of both. When the lectures were conducted face to face in the lecture room, extra precautions were exercised; for example, the staff and the students helped each other disinfect desks and devices every time between classes, in addition to other infection control measures such as installing partitions between desks.

Additional special measures are also taken. Supervisors were assigned to each student in late October, which was earlier than usual, and they started making regular online contact with students who could not come to Japan, hoping that such attempts would raise students' motivation toward thesis writing from the beginning of the training.

Despite all the difficulties, the students did excellently. They all completed the program with a master's degree without anybody infected with the disease. On top of that, the student who studied online through the entire period of the program, including supervision and thesis writing, received the Best Research Award, which is given to those who have created an excellent master's thesis.

Site visit to the Shinano-gawa River basin

JICA Closing Ceremony for the 14th batch of Master's Program (September 2021, at the ICHARM auditorium)

4.2 Doctoral program: Disaster Management Program

ICHARM started a doctoral program, "Disaster Management Program," in 2010 in collaboration with GRIPS to produce experts who are capable of developing policies on water-related disaster risk management and taking the leadership in implementing them.

By the end of 2020, 12 students from 5 countries completed the doctoral program.

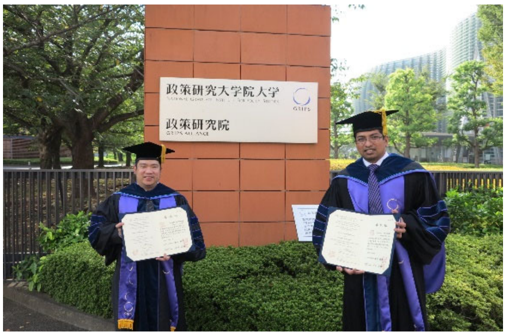
In September 2020, the 8th batch of 1 student graduated with a doctoral degree in disaster management. In October, the 11th batch of 2 students entered the program.

In September 2021, the 9th batch of 3 students graduated with a doctoral degree in disaster management. In October, the 12th batch of 3 students entered the program.

Currently, 5 doctoral students (2 second-year, 3 first-year students) are studying in the program.

Among the five students, one was enrolled in September 2020, and two were enrolled in September 2021 using JICA's new scholarship program for international doctoral students, "Disaster Risk

Reduction Leaders Capacity Development for the Sendai Framework Implementation." This program was realized in response to international discussions on water hazards, in which the importance of promoting cooperation between policy and science was stressed. It aims to help provide high-level training for individuals who are expected to assume an executive position in their governments in the future and has been implemented with the ICHARM training program and the GRIPS policy program.



Diploma Award Ceremony for JICA scholarship students of the 9th batch of Doctoral Program (September 2021, in front of the main gate of GRIPS)

In September 2021, two students obtained doctoral degrees using this scholarship.

4.3 Follow-up seminar for ICHARM alumni

ICHARM has held a Follow-up Seminar once a year since 2007 in a country of graduates from ICHARM educational and training programs to provide additional assistance and visit rivers and other places with water-related problems. This annual meeting is a great opportunity for ICHARM to see how graduates are using the knowledge and skills they learned at ICHARM and to share issues they face in their practices. Such information is used to improve ICHARM's training programs and enhance its research activities.

The FY2020 Follow-up Seminar was canceled due to the spread of COVID-19. However, in FY2021, ICHARM decided to hold one with the following objectives:

(1) To build a network of ICHARM staff and alumni and a network of alumni.

(2) To share the current situation and issues of water disaster risk management in each participating country and discuss solutions to improve the current situation and solve issues.

(3) To collect opinions and suggestions on training contents and training methods to utilize them for future development of training programs at ICHARM and PWRI.

For these purposes, ICHARM held the Follow-up Seminar online on February 25, 2022. Two special speakers and 69 master's and doctoral alumni participated.

4.4 Internship

ICHARM has accepted interns from both Japan and overseas. In 2020, ICHARM accepted two international interns: the Chinese intern from Sichuan University and the Cambodian intern from Kyoto University. In 2021, ICHARM accepted one international intern from a private company in Japan. The interns spent 6 months or 2 years at ICHARM studying hydraulic and hydrologic analysis, disaster risk analysis, or other subjects depending on their interest while getting technical advice from ICHARM researchers.

5. Information networking

5.1 IFI activities

5.1.1 Activities in individual countries

ICHARM has been promoting the global effort to establish Platforms on Water Resilience and Disasters, based on the Jakarta Statement, "Towards an interdisciplinary and transdisciplinary partnership to consolidate flood risk reduction and sustainable development," adopted at the side event of the 8th HELP meeting in Jakarta, Indonesia, in October 2016. In response, the participating organizations met at a workshop in January 2017 in Tokyo, Japan, and elaborated the basic action plan of IFI. Since then, ICHARM has been assisting the Philippines, Sri Lanka, and Indonesia in establishing a Platform on Water Resilience and Disasters.

In the Philippines, the effort to foster "Facilitators" is underway by utilizing OSS-SR developed on DIAS. An e-learning & workshop program was held for about a month from April 19 to May 17, 2021, in cooperation with the Department of Science and Technology Region 11 (DOST XI). The participants were required to view 10 lectures, take an online exam, and submit two assignments. In the end, 21 participants met all criteria and completed the course.

2021				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
April 19	April 20	April 21	April 22	April 23
9:00–12:00 **Opening Session** **Introduction: CC-1-3**	13:00–15:00 **Q & A Session: CC-1-3** **Introduction: FM-1-3**	Self-learning	13:00–15:00 **Q & A Session: FM-1-3** **Introduction: Exam**	Self-learning & Exam
April 26	April 27	April 28	April 29	April 30
13:00–14:00 **Review: CC, FM** **Introduction: DDR-1-4**	Self-learning & Exam	13:00–15:00 **Q & A Session: DDR-1-4** **Introduction: Assignment**	Self-learning, Exam, & Assignment	9:00–10:00 **Q & A Session: Assignment**
May 3	May 4	May 5	May 6	May 7
Self-learning, Exam, & Assignment	Self-learning, Exam, & Assignment	Due: **Exam and Assignment**	Evaluation by lecturers	Evaluation by lecturers
May 10	May 11	May 12	May 13	May 14
Evaluation by lecturers	Evaluation by lecturers	Evaluation by lecturers	Evaluation by lecturers	Evaluation by lecturers
May 17	May 18	May 19	May 20	May 21
10:00–12:00 **Closing Session**				

Schedule of the e-learning & workshop program for Davao City, the Philippines (April-May 2021)

In Sri Lanka, four plenary sessions for the Platform on Water Resilience and Disasters have been conducted since August 2017 with the participation of major water related organizations. ICHARM has conducted on-site and hands-on training on such topics as real-time flood forecasting systems for experts from the organizations. Currently, an OSS-SR is being developed, with which an e-learning and workshop program will be conducted online on the following topics: a) Flood early warning and risk mapping, b) Climate change adaptation planning; c) Economic damage assessment; d) Contingency planning; and e) Capacity building for Facilitators.

In Indonesia, a Platform on Water Resilience and Disaster was established in August 2019, consisting of the Ministry of Public Works and Housing (PUPR), the National Disaster Management Authority (BNPB), the Agency for Meteorology, Climatology, and Geophysics (BMKG), the Ministry of Environment and Forestry (KLHK), and the Ministry of Agriculture (KP). As part of this effort, an e-learning & workshop program was conducted from October to November 2021 in collaboration with ICHARM and the governmental, operational, educational, and research institutes of Japan, such as the Secretariat of the Water Cycle Policy Headquarters of the Cabinet Secretariat, MLIT, JMA, JWA, JAXA and Tohoku University.

The program aimed to provide capacity-building training for government officers and strengthen the collaboration among water-related ministries in order to help local stakeholders increase water-related disaster resilience and achieve sustainable development under climate change.

5.1.2 Activities for international and regional partnerships

ICHARM has participated in various international conferences and disseminated achievements and findings regarding the activities of IFI and the Platform through sessions and side-events organized concurrently with the main conferences.

The COVID-19 pandemic broke out in early 2020 and still continues today. Even in this crisis, communities and countries around the world need to prepare for the flood season annually, during which tremendous flood damage may result. To support them in such circumstances, ICHARM has been developing guidelines for early flood warning and evacuation with prevention measures against COVID-19. In the same context, it has also been developing an information sharing system for municipalities by utilizing existing information systems for disaster risk reduction, such as IDRIS, BOSS-SHIFT and DIAS. To disseminate these efforts to the IFI implementing countries and others, ICHARM hosted a webinar titled “ICHARM’s efforts for addressing flood disasters considering the prevention of COVID-19 infection” on July 3, 2020. The webinar was attended by more than 60 people, including high-level participants.

The AWCI Session was convened online on February 26, 2021, as the first task group of the 13th AOGEO Symposium, gathering more than 60 participants. After reviewing past AWCI activities and hearing the reports of the Platforms on Water Resilience and Disasters in the IFI implementing countries, a new framework and strategy for developing a localized OSS-SR and fostering on-site Facilitators were proposed and discussed. The discussion results were reflected in the statement of AOGEO.

The AWCI Session was also convened online on October 29, 2021, as a sectional meeting of the 14th AOGEO Symposium. More than 50 people participated, including directors from related organizations in the Philippines, Sri Lanka, and Indonesia. In this session, each country reported on the implementation status and future plan of the Facilitator training through e-learning. The session

Participants in the 14th AOGEO AWCI Session (October 29, 2021) also covered cutting-edge research and development topics in agriculture and food, climate change and water use, ecosystem-based disaster risk reduction, and floods and poverty. In conclusion, the session emphasized the necessity of promoting the Water Cycle Consilience in cooperation with various socio-benefit areas related to the Quality of Life (QoL), such as water-related disaster risk reduction, urbanization, ecosystems, food, energy, poverty, health, education, and labor. The idea of the Water Cycle Consilience was included in the final statement of AOGEO.

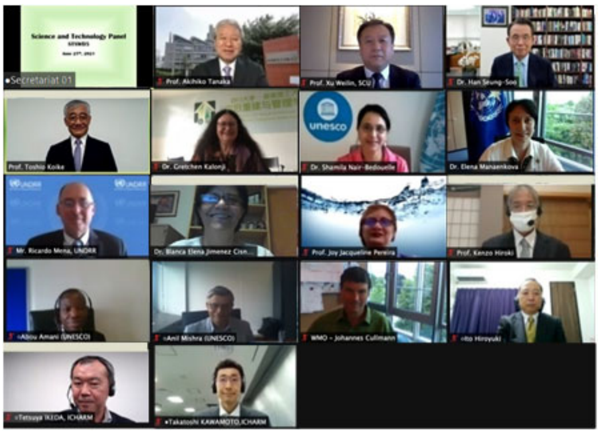
5.2 Contribution to the international community

5.2.1 Participation in and contribution to major international conferences

"The International Online Conference to Address Water-related DRR under the COVID-19 Pandemic" was held on August 20, 2020, which was jointly organized by HELP, UNDESA/UNCRD, ADB, GRIPS, and others. HELP created "Principles to Address Water-related Disaster Risk Reduction (DRR) under the COVID-19 Pandemic." The conference was attended by approximately 300 participants from 40 countries, including leaders, government officials, representatives of international, UN and civil-society organizations, and experts on DRR, water and health, and discussed effective ways to address water-related DRR under the COVID-19 pandemic. As an advisor of HELP, the ICHARM executive director served as one of the co-coordinators of the scientific and technology session entitled "Role of Science and Technology to Cope with Challenges on Water, Disaster, and COVID-19." An ICHARM senior researcher also presented a booklet, "Collection of Critical Situations during Flood Emergency Response," developed by ICHARM.

ICHARM has substantially and continuously participated in and supported UNSTSWD which has been held biennially since 2013. On June 25, 2021, the UNSTSWD5 was held online. Prior to it, ICHARM organized the S&T Panel, which was joined by more than 160 viewers worldwide. With the ICHARM executive director jointly facilitating the event, the representatives of UNESCO, WMO, UNDRR and other organizations made presentations and joined the panel discussion. The S&T Panel summarized the results into the concrete actions: open science policy, systemic solutions, integrated and science-based actions, and tripartite cooperation among science, policy and operation. The summary was reported at UNSTSWD5, convened soon after the S&T Panel. The outcomes are expected to be reported at the future global milestone events, including the mid-term review processes on the SDGs and the Sendai Framework on Disaster Risk Reduction 2015-2030.

In addition, ICHARM has continuously participated in and actively contributed to SWWWs by co-organizing sessions with



Participants of the S&T Panel of UNSTSWD5 (June 25, 2021) partner organizations and providing the presentations of its activities. Although SWWW was cancelled in 2020, ICHARM convened a session titled "Post COVID-19 River Basin Disaster Resilience, Sustainability & Sound Water Cycle" with HELP, MLIT, GRIPS, and the other organizations on August 24, 2021. ICHARM also co-organized another session titled "Accelerating Inclusive Water Governance to Advance Sustainable Development" with the APWF Secretariat and GWP on August 25.

In close partnership with relevant organizations, ICHARM is eagerly engaged in the preparatory activities as a session organizer of water and disasters/climate change at the 4th APWS to be held in April 2022 and as a conference organizer of ICFM9 in February 2023.

5.2.2 Contribution to the UNESCO-IHP

At present, UNESCO is developing the ninth phase of the Programme, IHP-IX 2022-2029. Since the 23rd session of the IHP Intergovernmental Council (IGC) in June 2018, discussions have continued at the UNESCO-IHP Secretariat, the IHP National Commissions of the member countries, UNESCO category II centres, the UNESCO Chairs, and other relevant organizations. Thanks to their efforts, the Strategic Plan of the IHP-IX 2022-2029 was presented at the 24th session of IHP-IGC held online in June 2021 and gained consensus at the 4th extraordinary session in September-October 2021. The Open-Ended Working Groups have continued discussing the Operational Implementation Plan and other issues, aiming to have the plan adopted at the 25th session of IHP-IGC in April 2022. The IHP-IX includes many issues related to water-related disasters and their risk management, such as the development of hydrological science and research, capacity development, and data collection and sharing. ICHARM researchers have participated in a series of discussions according to their professional backgrounds and will be trying to contribute to achieving the goals of the IHP-IX.

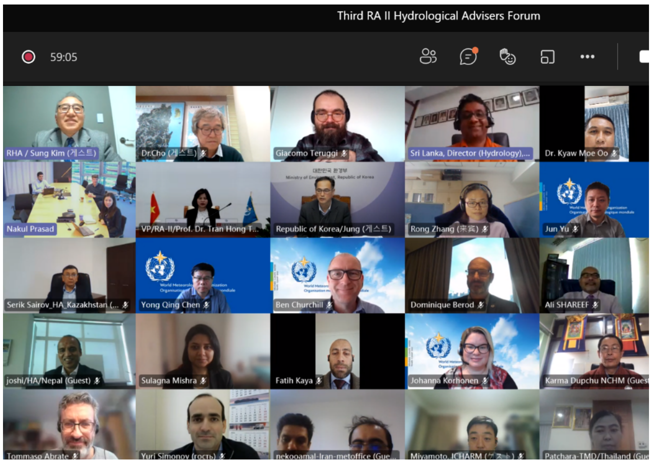
In partnership with UNESCO and AGRHYMET, ICHARM co-organized an information session of WADiRE-Africa as a joint project with UNESCO on December 1, 2021. In this session, the ambassador, permanent delegate of Japan to UNESCO, gave an opening address, followed by presentations by panelists, including the ICHARM executive director and an expert from VBA, who had training at ICHARM for the project.

In the Asia-Pacific region, ICHARM has participated in the meetings of the UNESCO-IHP Regional Steering Committee for Asia and the Pacific as one of the core organizations. After a one-year postponement due to the COVID-19 pandemic, the 28th meeting was held online on November 24~25, 2021. ICHARM presented its recent activities covering research, training, and networking and explained an e-learning training program implemented for local practitioners in Davao City, the Philippines, and Indonesia. Appointed as a member of the National Committee for the IHP, Science Subcommittee, the Japanese National Commission for UNESCO, ICHARM has contributed to UNESCO's operation by reporting its activities regularly.

5.2.3 Contribution to the field of hydrology

As hydrology is one of its important research areas, ICHARM has been participating in international workshops in this area to exchange views and ideas with other organizations. In particular, ICHARM has long contributed to various committees and programs of WMO.

An ICHARM researcher participated in the Support-Based Partners (SBP) Fora of the Associated Programme on Flood Management (APFM), a joint initiative of WMO and GWP. The meetings were so far held in August 2020, March 2021, and October 2021. In APFM, the Technical Support Unit (TSU) has been organized to develop and maintain a continuous cooperation framework with partners throughout the year. ICHARM has contributed to APFM as an SBP through such activities as the development of flood early warning systems in the Volta River basin and IFI Platforms on Water Resilience and Disasters in the Philippines, Sri Lanka, and Indonesia. ICHARM will also further cooperate with APFM to promote plans and projects based on the concept of Integrated Flood Management (IFM).



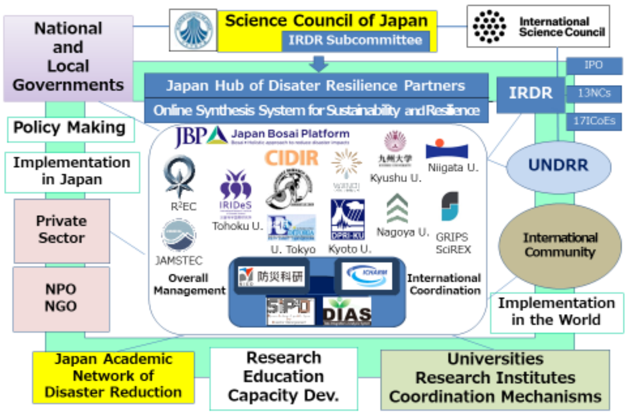
Participants in the third WMO RA II Hydrological Advisers' Forum

WMO RA II Hydrological Advisers' Fora were held in September 2020, March 2021, and November 2021 and discussed, from a hydrological perspective, future activities and cooperation in the Asian region under the new WMO management. Specifically, the fora discussed activities related to the Hydrological Coordination Panel (HCP) and two new technical commissions, Infrastructure Commission and Services Commission, established with the reorganization of WMO. An ICHARM researcher joined the discussions on activities of the regional HCP in Asia, building on the achievements of the former Working Group on Hydrological Services.

5.2.4 Contribution to DRR

The 3rd UNWCDRR, held in March 2015, adopted the Sendai Framework for Disaster Risk Reduction 2015-2030 as the new global policy for disaster management defining seven targets and four priorities for action. To develop an action plan for implementing the four priorities for action, the "International Conference on Science and Technology for Sustainability - Global Forum on Science and Technology for Disaster Resilience 2017 -" was held in Tokyo in November 2017, jointly organized by six entities, including PWRI. As a result of this forum, "Tokyo Statement 2017" was adopted, which proposed developing guidelines on national DRR platforms with support from science and technology, as well as producing periodic synthesis reports, in cooperation with all stakeholders. Based on these discussions, in 2020, SCJ published a recommendation entitled "Building a sustainable global society by strengthening disaster resilience: Developing an 'Online Synthesis System (OSS)' and fostering 'Facilitators' to realize consilience."

In line with these events, JHoP was established as a unique entity composed of prominent universities, research institutions and general associations involved in disaster resilience enhancement in Japan with support from the IRDR Japan National Committee and the Subcommittee for IRDR of SCJ, with NIED serving as its secretariat. JHoP aims to promote interdisciplinary and transdisciplinary research, education and social implementation and contribute to the creation of science-based disaster-resilient societies. It also seeks to implement the 2020 recommendation of SCJ by developing OSS-SR and fostering Facilitators for promoting coherence among DRR, CCA, and SDGs.



Structural image of JHoP

In addition, the IRDR ICoEs have been established in some major countries to develop an integrated approach to DRR that directly contributes to achieving the objectives and strategies of IRDR. In June 2021, the IRDR Japan NC sent a letter on "Expression On Interest" to establish the IRDR ICoE-Coherence for further strengthening the coherence among DRR, CCA and SDGs by conducting integrated research and implementation through international cooperation. At the 26th session of the IRDR SC meeting in October 2021, the proposal to establish the ICoE-Coherence was unanimously approved. Based on it, JHoP will play a leading role in promoting advanced and integrated activities internationally.

As a part of its activities, a public symposium was held online at the National Conference for Promoting Disaster Risk Reduction 2021 on November 6, 2021, under the title of "What is resilience to overcome national catastrophes for Japan in the 21st century - Strategy for establishing consilience of knowledge on disaster risk reduction." The symposium was jointly organized by JHoP and the Sub-committee for IRDR of the Committee for Civil Engineering and Architecture, which is part of SCJ. ICHARM contributed to this symposium by presenting an e-learning workshop organized with Davao City, the Philippines, as an activity led by the Platform on Water Resilience and Disasters under IFI. ICHARM also shared information about fostering Facilitators and developing an OSS-SR through the e-learning system.

At the 3rd UNWCDRR in 2015, ICHARM had made an active contribution by participating in various sessions and sharing knowledge and information with international participants. At the Global Forum 2017 in Tokyo, ICHARM played a central role in planning and operating the forum from the initial stage. ICHARM also demonstrated leadership in developing the recommendation of SCJ in 2020, establishing JHoP, and promoting its activities. Further, ICHARM has registered IFI activities in the Sendai Framework Voluntary Commitments Initiative, which is designed to support partnership development at all levels to implement the Sendai Framework for DRR.

5.2.5 Invited lectures

ICHARM researchers, including the executive director, were invited by international organizations and universities inside and outside Japan to give lectures or join discussions on water-related disasters and their risk management.

5.3 Contribution to the Typhoon Committee

TC is an intergovernmental community jointly organized in 1968 by UNESCAP and WMO to promote and coordinate the development and implementation of plans to minimize human and physical damage caused by typhoons in the Asia-Pacific region. The members are composed of governmental organizations of 14 nations and territories in East and Southeast Asia. The committee consists of four Working Groups of Meteorology, Hydrology, Disaster Risk Reduction, and Training and Research, each of which works on its projects independently. Integrated Workshops and Annual Sessions are also held periodically. The following lists the TC-related meetings held in the 2020-2021 period:

- The 9th Annual Meeting of WGH (Web conference; October 22, 2020)
- The 15th Annual Integrated Workshop (Web conference; December 1-2, 2020)
- The 53rd Annual Session (Web conference; February 23-25, 2021)
- The 10th Annual Meeting of WGH (Web conference; October 22, 2021)
- The 16th Annual Integrated Workshop (Web conference; December 2-3, 2021)
- The 54th Annual Session (Web conference; February 23-25, 2022)

ICHARM participated in the above discussions as the chair of WGH, led the discussions of WGH with MLIT, and worked on AOP-7 “Water Resilience and Disaster Platform in IFI,” which is one of the AOPs of WGH. As a result of AOP-7, ICHARM examined a method that can be implemented even under the pandemic of COVID-19 and provided an e-learning and workshops using OSS-SR in Davao City, the Philippines.

Participants at the 9th Annual Meeting of TC-WGH (October 22, 2020)

The 53rd Annual Session, held online in February 2021, announced that ICHARM was given the Dr. Roman L. Kintanar Award 2020 together with JAXA and IDI. This award was created in 2006 to commend institutions for significant contributions to the achievement of the mission and vision of TC in acknowledging the dedication in the struggle against typhoon-related disasters by Dr. Roman L. Kintanar, who was the coordinator of the TC secretariat. ICHARM was highly evaluated for its outstanding contribution to enhancing the flood forecasting and management capacity in the TC region by supporting the flood hazard mapping project of TC and utilizing the GSMaP product developed and provided by JAXA.

5.4 Leading the International Atomic Energy Agency (IAEA)/Regional Cooperative Agreement (RCA) IAEA RAS/7/035 Project (2020-2023)

Since the success of the IAEA RAS/7/030 Project implementation (2016-2019), ICHARM continues contributing to the IAEA RAS/7/035 Project between 2020 and 2023 on "Enhancing Regional Capability for the Effective Management of Ground Water Resources Using Isotopic Techniques" in response to requests from the MOFA of Japan by assigning an ICHARM research specialist as one of the national project coordinators and representatives of Japan for the following purposes:

- Conduct training for participants from the RCA member countries for the effective management of groundwater resources on the basis of comprehensive assessment using an integration of isotopic, hydrogeological and chemical techniques;
- Provide expert advice for specific study areas of the RCA member countries by answering questions on groundwater sources, recharge mechanisms, age and volumes;
- Promote the application of isotope techniques in Japan to characterize water cycles in subsurface and surface water components;
- Contribute to the research development of new numerical modeling technology and preparation of the next 3-year IAEA/RCA projects for reducing water-related disasters of floods and droughts.

For the IAEA RAS/7/035 Project, the representative of China was appointed to coordinate activities. However, all face-to-face meetings and the regional and national training courses were cancelled due to the COVID-19 pandemic from January 2020. To address this, the IAEA home-based expert engagement and e-learning training was adopted to continue preventing in-person international travel during the RAS/7/035 project. The ICHARM research specialist co-represented Japan with Prof. TSUJIMURA (Tsukuba University) and participated in the First Coordination Meeting of the project RAS/7/035, which was held online on September 10-11, 2020, sharing a proposed plan of isotope hydrology research in the Tokyo Metropolitan Area with other representatives from Australia, China, India, Indonesia, Lao, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam. After the First Coordination Meeting, the ICHARM research specialist was nominated as the IAEA Lecturer/Expert to provide online guidance by reviewing, interpreting and summarizing existing isotopic data for the study areas in the Philippines, Lao, Mongolia and Indonesia, with findings being prepared for a peer-reviewed journal publication.

5.5 Visitors

Date	Visitors & Affiliations	No. of Visitors	Purpose
March 5, 2020	JICA Myanmar and JICA Tsukuba	3	To visit a class (self-study) for observation and have a small meeting with Myanmar students and their supervisors.
July 5, 2021	JICA Development Studies Program and others	4	To collect information on foreign students studying in Japan for a JICA public-relations website.

Visitors from JICA Myanmar and JICA Tsukuba (March 5, 2020)

６． Academic field surveys in Japan and overseas countries

6.1 Study on a disaster caused by heavy rainfall in July 2020 in the Kuma River basin

ICHARM has been analyzing the mechanisms and phenomena of flood inundation, including sediment runoff, which has more frequently occurred across Japan in recent years, and studying effective information sharing methods during disasters.

Flood marks at the Aoi-Aso shrine

As part of this effort, we investigated flood damage in the Kuma River basin, including downtown Hitoyoshi City, due to record-breaking heavy rainfall from July 4 to 7, 2020, in the Kyushu region. As shown in the photo, near the national treasure Aoi Aso Shrine located in downtown Hitoyoshi City, we confirmed flood marks approximately 2.5 m higher than those of the July 1982 flood.

We will continue our efforts to characterize hazards from a geomorphological point of view, as well as to evaluate them from an engineering point of view.

6.2 Field survey on disaster damage caused by Typhoon No. 19 in 2019

Typhoon No. 19, which landed on the Izu Peninsula on October 12, 2019, while remaining large and strong, brought record-breaking rainfall over a wide area of Japan, causing considerable damage to many areas due to flooding and sediment-related disasters. ICHARM conducted a field survey in November and December 2019. As shown in the figure, Marumori Town has its downtown area near the confluence of the Uchikawa and Kizio Rivers, both tributaries flowing into the right bank of the Abukuma River. The town suffered 10 deaths, 1 missing person, 952 houses totally or partially destroyed, 827 houses flooded above floor level, and 194 houses flooded below floor level. The damage caused by sediment and flooding was most noticeable around the confluences where the Shin-kawa River or the Gofukuya River merges with the Uchikawa River and in the flat areas along the Uchikawa River, especially where the river topography changes drastically (e.g., decreases in the

Map of the Uchikawa River basin

Marumori Town after flood inundation with sediment gradient of the river). Where such sediment and flood inundation phenomena were pronounced, driftwood accumulation and deposition were also clearly observed. The photo shows part of Marumori Town after the sediment and flood inundation, where the Gofukuya River reaches the slope changing point down to the flat part. Sediment and flood inundation was also observed in the 2017 northern Kyushu torrential rain disaster and the 2018 western Japan heavy rainfall disaster, sharing many aspects in common with the phenomena observed in the Marumori Town case.

6.3 Field observation in the Shirakawa River

The Shirakawa River flows through Kumamoto Prefecture, originating in the Aso Caldera, running downstream through densely urbanized Kumamoto City, and finally emptying into the Ariake Sea. While enjoying rich water resources from the groundwater of the Aso Caldera, downtown Kumamoto City was devastated by a flood in 1953, when floodwaters containing large amounts of volcanic ash soil flooded its entirety. With the possibility that climate change may cause flood inundation equal to or greater than the 1953 flood in the future, it is very important to study possible hazards. To this end, in addition to its world-leading groundwater conservation, the city has decided to improve itself into a flood-resilient city and started its effort by conducting flood response drills with the participation of citizens and city officials.

To support this effort, ICHARM has been developing virtual reality (VR) tools, for example, a device to create virtual flooding. A field survey of the Shirakawa River was conducted in December 2021 to gain the basic knowledge needed for this invention. We investigated the grain size distribution of sediment deposited in the river channel and found that sediment of a wide range of grain sizes, from large boulders to fine sand, had deposited on the bed of the upper Shirakawa River in the Aso Caldera (left photo). We also found that the riverbed was covered with fine sand and silt in the lower reach, including the Kumamoto City area, with no boulders (right photo). This remarkable longitudinal sediment sorting is a characteristic of the Shirakawa River, and it is assumed that heavy rainfall helps supply a large amount of fine sediment to the river channel and that the fine sediment is transported downstream by floodwaters. Based on the field survey results, we are planning to conduct flood inundation simulations with large amounts of sediment.

Sediment size survey in an upstream area

Sediment size survey in a downstream area

7. Public relations and other important activities

7.1 Awards

The following lists the awards received by researchers of ICHARM for their quality research, presentations and academic papers in the 2020-2021 period.

ICHARM has “ICHARM BEST PAPER AWARD” mainly to encourage young researchers at ICHARM. Every year, the selection committee selects and examines papers of ICHARM researchers published in international journals for creativity and relevancy in terms of water-related disaster risk reduction, and finally decides the best paper for the prize.

7.1.1 Best Paper Award in the Asia and Pacific Regional Division of International Association for Hydro-Environment Engineering and Research (IAHR-APD)

Research Specialist Robin Kumar Biswas, Research and Training Advisor EGASHIRA Shinji and Research Specialist HARADA Daisuke: Variability in Stage-Discharge Relationships in River Reach with Bed Evolutions, 22nd IAHRAPD Congress in Sapporo, Japan, September 15-16, 2020 (online).

7.1.2 2020 GEO Individual Excellence Award

KOIKE Toshio

7.1.3 Dr. Roman L. Kintanar Award 2020

ICHARM, the Japan Aerospace Exploration Agency (JAXA), and the Infrastructure Development Institute (IDI)

7.1.4 Research Encouragement Award 2020 by Japanese Geomorphological Union

NAGUMO Naoko: Geomorphological analysis on flood and sediment hazards in the Omoto River resulting from Typhoon Lionrock in 2016

7.1.5 Young Best Presentation Award by Japan Society of Erosion Control Engineering

HARADA Daisuke: 多量の土砂を含む洪水氾濫流の特徴 -2019 年五福谷川洪水を例に-

7.1.6 International Lifetime Contribution Award by JSCE

KOIKE Toshio

The fiscal year 2020 JSCE award ceremony (June 11, 2021)

7.2 ICHARM Open day

On April 14, 2021, the 12th ICHARM Open Day was held online for the first time in its history, gathering 81 high school students and 28 secondary school students in Tsukuba City. The ICHRAM Open Day is an annual event held every April during the Tsukuba Science and Technology Week. Up to 2019, local school students visited ICHARM and enjoyed face-to-face interaction with international students studying in the master's or doctoral program at ICHARM. In 2020, when the COVID-19 pandemic broke out, the event was canceled. In 2021, although other open-house events hosted by PWRI were canceled, ICHARM decided to hold the yearly event online. The Open Day began with a keynote lecture entitled "Climate Change and Floods." Then, ten master's or doctoral students from seven different countries (Tonga, Malaysia, Myanmar, Bangladesh, Bhutan, Mauritius and Ethiopia) spoke about their countries from various aspects, including geography, history, culture, and water-related disasters.

7.3 ICHARM R&D Seminars

ICHARM R&D Seminars are held on an irregular basis as an opportunity for researchers to keep up with the latest knowledge and information by inviting domestic and international experts in the field of hydrology and water-related disasters. In the 2020-2021 period, three seminars were held, as shown in the table below. All of them attracted many participants, including those from PWRI and NILIM.

67th ICHARM R&D Seminar (November 30, 2021)

No.	Date	Speaker	Affiliation	Title
65	December 1, 2020	Assoc. Prof. NUMADA Muneyoshi	the Institute of Industrial Science, the University of Tokyo	Approach from the disaster management process and development of the BOSS (Business Operation Support System) for the comprehensive disaster management
66	March 29, 2020	Prof. IZUMI Norihiro	Faculty of Engineering, Hokkaido University	Boundary instabilities observed in rivers
67	November 30, 2021	Dr. YOSHINO Naoyuki	Emeritus professor of Keio University and the executive director of the Financial Research Center	Private Financing in infrastructure by use of spillover tax revenues and Its application to the estimates of disaster damage

7.4 ICHARM Webinars

ICHARM held online events, “ICHARM Webinars,” to widely share research activities at ICHARM with those interested, particularly M.Sc. or Ph.D. students and young researchers of universities and research institutes in Japan. At the webinars, research projects of ICHARM were outlined in various fields: meteorology, hydrology, sediment transport and channel changes, and disaster risk reduction. The participants attended parallel sessions on different research themes of their interest and exchanged views and ideas with ICHARM researchers. The webinars held in 2020-2021 are as follows:

- In 2020: December 9, 2020 (Participants: 14)
- In 2021: December 13, 2021 (Participants: 24)

7.5 Research Meeting

The Research Meeting has been held roughly once a month since March 2008 for researchers to upgrade their research skills, learn different perspectives, and practice interaction with other researchers. During the 2020-2021 period, the meeting was held 23 times.

7.6 Newsletters and website

The ICHARM Newsletter has been published four times a year since March 2006 to publicize its activities of research, education and training, and local practice projects, as well as a list of published papers. During the 2020-2021 period, the newsletter was published eight times from No. 56 of April 2020 to No. 63 of January 2022. The number of subscribers has reached as many as 5,000. Since No. 56 of April 2020, “Editor’s Note” by the editorial committee members has been added, and since No. 60 of April 2021, online survey has been conducted to further improve the contents. More efforts have been made to diversify news topics by collecting disaster-related contributions from people outside ICHARM. For example, the January 2021 issue carried an article addressing Japan Railway’s response to the damage caused by Typhoon Hagibis in 2019.

ICHARM Newsletter No. 62

On ICHARM’s website, “What’s New” shows progress in research and projects in addition to the latest information and notifications about upcoming events. A new section has been created to receive comments and opinions from viewers around the world, and efforts have been made to respond to inquiries quickly and adequately.

ANNEX 1

Number of Alumni of ICHARM training program (As of March 2022, with possibility)

Ph.D. Program "Disaster Management"

Country / Year	Afghanistan	Bangladesh	Bhutan	Bosnia-Herzegovina	Brazil	Burkina Faso	Cambodia	China	Colombia	El Salvador	Ethiopia	Djibouti	Fiji	Guatemala	India	Indonesia	Japan	Kenya	Laos	Malaysia	Malawi	Maldives	Mauritius	Mozambique	Myanmar	Nepal	Netherland	Niger	Nigeria	Pakistan	Papua New Guinea	Philippines	Republic of Albania	Serbia	Sri Lanka	Tajikistan	Tanzania	Thailand	Timor-Leste	Tonga	Tunisia	Venezuela	Vietnam	Zimbabwe	Liberia	Total	(Number of students conferred degree)
2010-2013																	1																													1	1
2011-2014											1															1	1																			3	1
2012-2015		1												1																																2	2
2013-2016		2												1																																3	3
2014-2017																										1																1				2	0
2015-2018		1																												1																2	2
2016-2019		1																												1																2	2
2017-2020		1																																												1	1
2018-2021																	1																		1								1			3	3
2019-2022																																														-	-
2020-2023		1									1																																			2	-
2021-2024																										1						1			1											3	-
Total	0	7	0	0	0	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	3	1	0	0	2	0	1	0	0	2	0	0	0	0	0	0	1	1	0	0	24	15
Master's. Program "Water-related Disaster Management Course of Disaster Management Policy Program"																																																
2007-2008		2						3							1		3									1						1														11	10
2008-2009		2						2			1					1										1												2								9	7
2009-2010		2						1			1					3	1								1							1			2			1								13	12
2010-2011		2						2	1					1		1									1	3				1																12	12
2011-2012		2						2					1			2										2				6		1			1						1		1			19	19
2012-2013		2							1											2					1	1			1				1	1	1							1				12	12
2013-2014		2						1		1								1							1					1		2			2							1				12	12
2014-2015		1							1				1		2			3							1					2					2											13	13
2015-2016		2			1																	1			1	1				2		1			2				1					1		13	13
2016-2017					1																1			1	1					2	1	1							1				2			11	8
2017-2018		2			1								1		1											2				2		1			2		1						1			14	14
2018-2019		1													1										1	1				1		1			1										1	8	7
2019-2020		2	2		2																				2	2				1																11	11
2020-2021		1	2																	1			1		1															1						7	7
2021-2022		2	1													1				2	1					1						2			3											13	-
Total	0	25	5	0	5	0	0	11	3	1	2	0	3	1	5	8	4	4	0	5	2	1	1	1	11	15	0	0	1	18	1	11	1	1	16	0	1	3	2	1	1	2	4	1	1	178	157
JICA training program "Flood Hazard Mapping"																																																
2004							2	2								2			3	2												2						2					1			16	
2005							2	2								2			2	2												3						1					2			16	
2006							2	2								2			2	2												2						2					2			16	
2007							2	2								3			2	3												2			1			3					2			20	
2008							1	2											2	2												1						1					1			10	
Total							9	10								9			11	11												10			1			9					8			78	
JICA training program "Local Emergency Operation Plan with Flood Hazard Map"																																																
2009		1	1													2			1						1					1					1	1		1								10	
2010		1	2													2			1						1	1				1					1	1		1								12	
2011		1	2													2			2						1					1					1	1										11	
Total		3	5													6			4						3	1				3					3	3		2								33	
JICA training program "Capacity Development for Flood Risk Management with IFAS"																																																
2012(A)		3																3											2			2						3								13	
2012(B)																																											7			7	
2013		3																3											2			3						2					3			16	
2014		3	3															3											3			3						3					2			20	
2015			1	2								1						2							4				2			4			2			2								20	
2016			2	1											1			4							2				2			4			2											18	
2017				1											1			2							2							2			2											10	
Total		9	6	4	0		0	0	0	0	0	1	0	0	2	0	0	17	0	0	0	0		0	8	0	0		11	0	0	18	0	0	6	0	0	10	0		0	0	12	0	0	104	
JICA training program "Capacity Development for Adaptation to Climate Change"																																																
2010		1														3																1						1					1			7	
UN/ISDR Training course "Comprehensive Tsunami Disaster Prevention"																																																
2008															2	4						2													3											11	
UNESCO Pakistan Project workshop																																																
2012																														6																6	
2013																														5																5	
2016	2																													2																4	
2017	2																													2																4	
Total	4																													15																19	
UNESCO West Africa Project																																																
2019						2																						1																		3	
Country / Year	Afghanistan	Bangladesh	Bhutan	Bosnia-Herzegovina	Brazil	Burkina Faso	Cambodia	China	Colombia	El Salvador	Ethiopia	Djibouti	Fiji	Guatemala	India	Indonesia	Japan	Kenya	Laos	Malaysia	Malawei	Maldives	Mauritius	Mozambique	Myanmar	Nepal	Netherland	Niger	Nigeria	Pakistan	Papua New Guinea	Philippines	Republic of Albania	Serbia	Sri Lanka	Tajikistan	Tanzania	Thailand	Timor-Leste	Tonga	Tunisia	Venezuela	Vietnam	Zimbabwe	Liberia	Total	
Total	4	45	16	4	5	2	9	21	3	1	4	1	3	3	9	30	6	21	15	16	2	3	1	1	22	19	1	1	12	38	1	41	1	1	31	3	1	25	2	1	1	3	26	1	1	457	

ANNEX 2

List of the Master Theses in 2019-20 &2020-21

Year	Country	Title
2019-2020	Bangradesh	A Numerical Study on Bank Erosion of a Braided Channel: Case Study of the "Tangail and Manikganj Districts along the Brahmaputra River"
	Bangradesh	Study on Flow Pattern and Associated Bed Deformation in the Off-Take Region of Gorai River, Bangladesh
	Bhutan	Comprehensive Evaluation of Flood Mitigation Measures Based on Climate Change Impact Assessmet in the Wangchu Basin
	Bhutan	Assessment of Water Resources Under Changing Climate for Effective Hydropower and Agriculture Productions in Puna Tsangchhu Basin, Bhutan
	Brazil	Flood Impact Assessment in the Itapocu River Basin, Brazil
	Brazil	Hazardous Area Resulting From Tailings Dam Failure
	Myanmar	Developing An Integrated Water Resources Management Plan for Chindwin RIiver Basin Under Changing Climate
	Myanmar	Analyzing River Morphological Changes and Formulating No Regret Structural Measures in Chindwin River
	Nepal	Numerical Study for Influences of Flow Diversion on Channel Morphology Case Study of Bagmati River, Central Nepal
	Nepal	Morphological Study of Koshi River at Chatara And Its Influence on Intake of Sunsari Morang Irrigation Project, Nepal
	Pakistan	Climate Change Impact Assessment on the Flood Risk Change in Kech River, Turbat Balochistan, Pakistan
2020-2021	Bangladesh	A Study on the Morphological Characteristics of Dawki-Piyan River System in Bangladesh
	Bhutan	Assessment of Integrated Water Resources Management under Climate Change in Wangchu Basin, Bhutan
	Bhutan	Impact Assessment on Extreme Floods due to Climate and Social Changes in the Amochu Basin, Bhutan
	Malaysia	Flood Damage Inspection Method for Public Building in Malaysia
	Mauritius	A Study on an Integrated Water Resources Management Plan Under Climate Change for Grand River North West River Basin, Mauritius
	Myanmar	Method for Predicting the Sediment Runoff Process due to Heavy Rainfall in the Yazagyo Reservoir Basin, Myanmar
	Tonga	Impact of Climate Change, Sea-Level Rise in Tongatapu, Ha'apai and Its Effect on Liverlihood

ANNEX 3

List of Ph. D. Theses accepted in FY2020＆2021

Year	Country	Title
2017 -2020	Bangladesh	Numerical Study On Tidal Currents And Bed Morphology In Sittaung River Estuary, Myanmar
2018-2021	Sri Lanka	A Study On Climate Change Adaptation And Resilience Strategies For Optimizing Benefits Of The Mahaweli River Basin In Sri Lanka
2018-2021	Vietnam	Integrated Operation Of Reservoirs For Maximizing Hydropower And Reducing Flood Risk
2018-2021	Japan	流域治水の推進に必要な合意形成のための減災対策による被害軽減効果の評価手法の研究

ANNEX 4

List of Research Theme of Internship

Year	Country	Affiliation	Title
FY 2020	China	Sichuan University	Development of a Global System for Flood Risk Early Warning
	Cambodia	Kyoto University	Study on flood forecasting using Rainfall-Runoff-Inundation Model
FY 2021	Japan	Private company	Study on the development of integrated water resources management plan for Kerala Rivers, India

ANNEX 5

ICHARM Publication List (April 2020 ~ March 2022)

A. Peer Reviewed Papers

- 原田大輔、江頭進治、柿沼太貴、南雲直子、伊藤弘之、2019年台風19号による阿武隈川水系五福谷川における多量の土砂を含む洪水流の特徴、河川技術論文集、No.26、pp.609-614、河川技術シンポジウム（大会開催はキャンセル）、2020年6月
- 柿沼太貴，中村要介，伊藤弘之，池内幸司，複数洪水イベントの組み合わせによる洪水予測に適したRRIモデルパラメータの最適化手法に関する検討, 河川技術論文集、No.26、pp.199-204、河川技術シンポジウム（大会開催はキャンセル）、2020年6月
- Rie Seto, Kentaro Aida, Toshio Koike and Shinjiro Kanae, Radiative Characteristics at 89 and 36 GHz for Satellite-Based Cloud Water Estimation Over Land, IEEE Transactions on Geoscience and Remote Sensing, Vol.59, Issue2, pp.1355-1368, February 2021
- 南雲直子、江頭進治、地形解析に基づく中山間地河川の土砂輸送過程に関する研究、地理学評論、Vol.94、pp.64-81、2021年3月
- Hemakanth Selvarajah, Toshio Koike, Mohamed Rasmy, Katsunori Tamakawa and Akio Yamamoto, Development of an Integrated Approach for the Assessment of Climate Change Impacts on the Hydro-Meteorological Characteristics of the Mahaweli River Basin, Sri Lanka, Water MDPI Open Access Journals, Vol.13, Issue9, 1218
- Naofumi Akata, Hideki Kakiuchi, Masahiro Tanaka, Yoshio Ishikawa, Naoyuki Kurita, Masahide Furukawa, Miklos Hegedus, Tibor Kovacs, Maksym Gusyev, Tetsuya Sanada (2021). Isotope and chemical composition of monthly precipitation collected at Sapporo, northern part of Japan during 2015-2019. Fusion Engineering and Design 168: 112434
- Hiroyuki Tsutsui, Yohei Sawada, Katsuhiro Onuma, Drought Monitoring over West Africa Based on an Ecohydrological Simulation (2003-2018), Hydrology, Vol.8, No.155, pp.1-16, October 2021
- 江頭進治、竹林洋史、萬矢敦啓、原田大輔、土石流・掃流砂・浮遊砂・泥流の統一解析法、土木学会論文集B1（水工学）、Vol.76、No.2、pp. I_1123-I_1128、2020年11月
- 牛山朋來、中村要介、伊藤弘之、令和元年台風第19号に伴う千曲川洪水のアンサンブル洪水予測シミュレーション、土木学会論文集B1（水工学）、Vol.76、No.2、pp. I_235-I_240、2020年11月
- 中村要介、江頭進治、池内幸司、柿沼太貴、RRIモデルと河床変動予測モデルを組み込んだ粒子フィルタによる河川水位予測、土木学会論文集B1（水工学）、Vol.76、No.2、pp. I_859-I_864、2020年11月
- 原田大輔、江頭進治、連行速度を用いた浮遊砂の解析法、土木学会論文集B1（水工学）、Vol.76、No.2、pp. I_1111-I_1116、2020年11月
- 大原美保、栗林大輔、藤兼雅和、地方自治体職員が直面する水害対応ヒヤリ・ハット事

例の分析、土木学会論文集F6（安全問題）、Vol.76、No.2、pp.I_81-I_88、2021年2月

- 柿沼太貴、沼田慎吾、望月貴文、大沼克弘、伊藤弘之、安川雅紀、根本利弘、小池俊雄、池内幸司、中小河川を対象とした洪水時におけるリアルタイム水位予測システムの開発に向けた研究、河川技術論文集、Vol. 27、pp.105-110、2021年6月
- 小池俊雄、中村 茂、Cho Thanda Nyunt、発電ダムの洪水調節と発電操作支援システム、土木学会論文集B1（水工学）、Vol.77、No.2、pp. I_79-I_84、2021年10月
- 玉川勝徳、MOHAMED Rasmy、NASEER Asif、犀川流域におけるダム流入量のアンサンブル予測手法の検討、土木学会論文集B1（水工学）、Vol.77、No.2、pp. I_61-I_66、2021年10月
- Islam Md Masbahul, Atsuhiro Yorozuya, Daisuke Harada and Shinji Egashira, A Numerical Study on Bank Erosion of a Braided Channel: Case Study of the "Tangail and Manikganj Districts Along the Brahmaputra River", Journal of Disaster Research (JDR), pp.263-269, Vol.17, No.2, February, 2022
- Miyamoto, M.; Kakinuma, D.; Ushiyama, T.; Rasmy, A.W.M.; Yasukawa, M.; Bacaltos, D.G.; Sales, A.C.; Koike, T.; Kitsuregawa, M. Co-Design for Enhancing Flood Resilience in Davao City, Philippines. Water 2022, 14, 978. https://doi.org/10.3390/w14060978

B: Non-peer Reviewed Paper

- HARADA Daisuke, EGASHIRA Shinji and ITO Hiroyuki, Characteristics of active sediment transport processes in extreme flood hazards, Proceedings of River Flow 2020, pp.1908-1916, July 2020
- 傳田正利、諸岡良優、藤兼雅和、気象庁55年長期再解析・降雨流出氾濫モデル及び地理情報システムを用いた過去の洪水状況の再現と水災害史研究への活用可能性に関する研究、土木史研究講演集、pp.9-15、土木史研究講演会、2020年7月
- Robin K. Biswas, EGASHIRA Shinji, HARADA Daisuke and ITO Hiroyuki, Evaluation of geomorphological characteristics in a quasi-equilibrium river channel, Proceedings of River Flow 2020, Proceedings of River Flow 2020, pp.439-447, July 2020
- HARADA Daisuke and EGASHIRA Shinji, Erosion rate of bed sediment in terms of entrainment concept, 22nd IAHR-APD CONGRESS 2020 IN SAPPORO, 1-2-3, September 2020
- Robin K. Biswas, S. Egashira, and D. Harada; Variability in Stage-Discharge Relationships in River Reach with Bed Evolutions, 22nd IAHR-APD CONGRESS 2020 IN SAPPORO, 1-3-2, September 2020
- Tanjir Saif Ahmed, Shinji Egashira, Daisuke Harada; TIDAL CURRENTS AND SAND BAR EVOLUTION IN SITTAUNG RIVER ESTUARY, MYANMAR, 22nd IAHR-APD CONGRESS 2020 IN SAPPORO, 1-2-5, September 2020

C: Oral Presentation

- HARADA Daisuke, EGASHIRA Shinji and ITO Hiroyuki, Characteristics of active sediment transport processes in extreme flood hazards, Proceedings of River Flow 2020, River Flow 2020 (Online), July 6-10, 2020

- 傳田正利、諸岡良優、藤兼雅和、国土数値情報等と氾濫シミュレーションを用いた仮想洪水体験システムの開発、安全工学シンポジウム2020講演予稿集、pp.96～97、安全工学シンポジウム2020、2020年7月1日～2日
- Robin K. Biswas, EGASHIRA Shinji, HARADA Daisuke and ITO Hiroyuki, Evaluation of geomorphological characteristics in a quasi-equilibrium river channel, Proceedings of River Flow 2020, Proceedings of River Flow 2020, River Flow 2020 (Online), July 6-10, 2020
- 傳田正利、諸岡良優、藤兼雅和、気象庁55年長期再解析・降雨流出氾濫モデル及び地理情報システムを用いた過去の洪水状況の再現と水災害史研究への活用可能性に関する研究、土木史研究講演集、pp.9～15、土木史研究講演会、2020年7月11日～12日
- KOIKE Toshio, Strengthening governance and investment for water-related disaster resilience under climate change in Asia, Jｐ GU-AGU Joint Meeting 2020 (Online), July 12-16, 2020
- KOIKE Toshio, Satellite-based Data Assimilation Systems by Using Microwave Radiometers, Jｐ GU-AGU Joint Meeting 2020 (Online), July 12-16, 2020
- Gusyev M., AKATA N., YAMANAKA T., HIRABAYASHI K. and Morgenstern U., Comparing tritium concentrations and water transit times in the Chikuma and Fujikawa River basins, Japan, JpGU-AGU Joint Meeting 2020 (Online), July 12-16, 2020
- HARADA Daisuke and EGASHIRA Shinji, Erosion rate of bed sediment in terms of entrainment concept, 22nd IAHR-APD CONGRESS 2020 IN SAPPORO, IAHR=APD (Online), September 14-15, 2020
- Robin K. Biswas, S. Egashira, and D. Harada; Variability in Stage-Discharge Relationships in River Reach with Bed Evolutions, 22nd IAHRAPD Congress in Sapporo, Japan, September 15-16, 2020 (Online)
- Tanjir Saif Ahmed, Shinji Egashira, Daisuke Harada; TIDAL CURRENTS AND SAND BAR EVOLUTION IN SITTAUNG RIVER ESTUARY, MYANMAR, 22nd IAHRAPD Congress in Sapporo, Japan, 1-2-5, September 15-16, 2020 (Online)
- 江頭進治、竹林洋史、萬矢敦啓、原田大輔、掃流砂・土石流・浮遊砂・泥流の統一解析法、第65回水工学講演会（Online）、土木学会水工学委員会、2020年11月4日～6日
- 牛山朋來、中村要介、伊藤弘之、令和元年台風第19号に伴う千曲川洪水のアンサンブル洪水予測シミュレーション、第65回水工学講演会（Online）、土木学会水工学委員会、2020年11月4日～6日
- 中村要介、江頭進治、池内幸司、柿沼太貴、RRIモデルと河床変動予測モデルを組み込んだ粒子フィルタによる河川水位予測、第65回水工学講演会（Online）、 土木学会水工学委員会、2020年11月4日～6日
- 原田大輔、江頭進治、連行速度を用いた浮遊砂の解析法、第65回水工学講演会（Online）、土木学会水工学委員会、2020年11月4日～6日
- 大原美保、栗林大輔、藤兼雅和、水害対応ヒヤリ・ハット事例集（地方自治体編および

新型コロナウイルス感染症への対応編）の作成、日本災害情報学会第22回学会大会予稿集、日本災害情報学会第22回学会大会（Online）、日本災害情報学会、2020年11月28日～29日

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- 大原美保、藤兼雅和、令和2年7月豪雨災害の被災地におけるコロナ禍での水害対応ヒヤリ・ハット事例、第39回日本自然災害学会学術講演会、pp.81-82、日本自然災害学会（Online）、2021年3月19日～20日
- Egashira S., Robin K. Biswas, Tanjir Saif Ahmed, Shahinur Shawn and Harada D., Fine sediment transport and river morphology, 8th International Conference on Water and Flood Management (ICWFM) 2021, Institute of Water and Flood Management (IWFM), Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh (Online), March 29-31, 2021
- 原田大輔、江頭進治、多量の土砂を含む洪水氾濫流の特徴 -2019年五福谷川洪水を例に、令和3年度（公社）砂防学会研究発表会概要集、令和3年度（公社）砂防学会研究発表会（Online）、（公社）砂防学会、2021年5月、pp.27-28、2021年5月19日～21日
- 柿沼太貴、沼田慎吾、望月貴文、大沼克弘、伊藤弘之、安川雅紀、根本利弘、小池俊雄、池内幸司、中小河川を対象とした洪水時におけるリアルタイム水位予測システムの開発に向けた研究、河川技術論文集、2021年度河川技術に関するシンポジウム（Online）、土木学会、pp.105-110、第27号、2021年6月10日～11日
- 大原美保、藤兼雅和、地方自治体の建設関連部局での水害対応ヒヤリ・ハット事例の分析、地域安全学会春季研究発表大会梗概集、No.48、pp.189-192、地域安全学会（Online）、2021年5月21日
- Daiki Kakinuma, Mamoru Miyamoto, Yosuke Nakamura, Anurak Sriariyawat, Supattra Visessri, Development of industrial park scale flood inundation analysis model for establishing and evaluating BCP/BCM, Asia Oceania Geosciences Society 18th Annual Meeting (AOGS2021) (Online), August 1-6, 2021
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- 小池俊雄、「変化を乗り越え、誇りある流域づくり」、吉田川流域治水シンポジウム、

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- Shrestha B.B., Kawasaki A., and Inoue T., Impact of Rainfall Variability on Rice Yield in Burma during Historical Colonial Period, Annual Conference on Asian Network for GIS-based Historical Studies 2021 (ANGIS Tokyo 2021) (Online), Asian Network for GIS-based Historical Studies (ANGIS), December 4-5, 2021
- 小池俊雄、中村 茂、Cho Thanda Nyunt、発電ダムの洪水調節と発電操作支援システム、第66回水工学講演会・水工学論文集、第66回水工学講演会（Online）、土木学会、2021年12月8日
- 玉川勝徳、MOHAMED Rasmy、NASEER Asif、犀川流域におけるダム流入量のアンサンブル予測手法の検討、土木学会論文集B1(水工学)、第66回水工学講演会（Online）、土木学会、Vol.77、No.2、I_61-I_66、2021年12月8日～10日
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- 小池俊雄、気候の変化と水災害の激甚化への対応、エコひろば市民講座、あったかホール、2022年1月19日
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ANNEX 6

Appraisal of the ICHARM Work Plan

FY 2021 (2021.4 – 2022.3)

Appraisal of the ICHARM Work Plan adopted at Governing Board meeting on 12 May 2021

Category	Content	Activities and expected results in FY2021	Self-assessment of achievements S…Excellent, more than planned A…Good, as planned B…Satisfactory, less than planned C…Poor, far less than planned	FY2021 Achievements
(i) Innovative research				
(a) Technology for constantly monitoring, storing and using disaster information				
Methods will be proposed for disaster data collection and basic database development with their practical applications. This should eventually lead to data analysis using a Data Integration and Analysis System (DIAS). A data correction method will be also proposed to be used in the process of building a database using global data and near-real time data from satellites. The impact of disaster reduction will be assessed quantitatively by the disaster database including its use in model areas both in Japan and overseas.				
(i)-(a)-1. Research on simple methods for assessing the socio-economic impact of flood disasters	Develop a simple method for assessing the socio-economic impact of flood disasters	In collaboration with GRIPS, assess the impact of indirect damage using a simple damage estimation method employing macroeconomic indicators for Joso City, which suffered extensive damage from the 2015 Kinugawa River flood, and its neighboring municipalities of a similar size, which did not suffer any damage.	① Overall evaluation 〔 A 〕 ② Publication 〔 B 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 B 〕	Analyzed the gross municipal product of disaster-affected cities: Sanjo City, Niigata Prefecture, affected by a flood in 2011; Joso City, Ibaraki Prefecture, severely damaged by a flood due to the Kinugawa River levee breach in 2015; and Inashiki City, Ibaraki Prefecture, whose gross product is similar to that of its neighboring Joso City. The results suggested that if the flood damage reaches as large as 50% of a municipality's gross product, it would cause a great impact on its gross product.
	Among the developed simple methods for assessing the socio-economic impact of flood disasters, test a globally applicable method by estimating such impact at national and global levels.	While remaining unable to collect data from the Philippines due to the COVID-19 pandemic, continue to apply the simple damage estimation method to the Philippines and Indonesia. Also implement climate change adaptation measures in Davao, the Philippines, using the Online Synthesis System (OSS) with e-learning as the main component.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	Developed an "Online Synthesis System" on DIAS for the Davao River basin in the Philippines. The system is designed to collect knowledge and information on real-time flood monitoring/prediction and climate change impact assessment and allow local stakeholders to learn them through e-learning. This e-learning function was used to train "Facilitators." The new system and training contributed to raising awareness of flood damage reduction in the region and laid the foundation for assessing the social impact of floods suitable for the region.
(b) Support system for early warning capable of providing accurate information in a shorter period of time				
More advanced application of a regional atmospheric model (WRF) and further improvement of IFAS and RRI will be achieved. Using these advanced technologies, a method will be developed for more accurate real-time prediction of rainfall, runoff and inundation to ensure over 10 hours of lead time necessary for evacuation in a wide area and dam discharges prior to rainfall. The developed method will be tested for applicability to river basins both in Japan and overseas with different conditions of data availability, climate and topography, and eventually used to establish an early flood warning and system. A technology will be developed to evaluate water disaster hazards by using satellites and sediment hydraulic models.				
(i)-(b)-1. Research on technologies for more accurate real-time prediction of runoff and inundation by	Improve the accuracy of the flood inundation prediction model by upgrading the flood tracking method and	Develop methods for creating RRI models for rivers for which the relationship between the water level and the flow rate is unknown due to the lack of river channel and other information and rivers with no flood events or insufficient flood observation data. Develop methods for estimating parameters based on the	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance	Proposed a method for creating H-Q equations from cross-sectional and other data and added a calculation function to the RRI-GUI to create H-Q equations easily. A method for rivers without cross-sectional data was also proposed to calculate water levels using flow rates calculated from rectangular cross-sections based on the regime rule assumed in the RRI

complementing insufficient data availability	introducing an automatic parameter optimization method.	characteristics of rivers by utilizing the verification results obtained so far.	〔 A 〕 ④ Social significance 〔 S 〕 ⑤ Dissemination 〔 A 〕	model. In addition, a method for estimating parameters from river characteristics in rivers lacking flood observation data was developed by sorting out model parameters for about 130 rivers and conducting statistical analysis.
	Clarify the applicability of satellite rainfall data and develop a basin-specific data correction method.	Continue verifying this method by applying it to different regions since the precipitation phenomenon varies locally to a great degree. Study issues related to the development of components, which will be applied to RRI and other models.	① Overall evaluation 〔 A 〕 ② Publication 〔 S 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	Studied the optimization of the placement and number of ground rain gauges in the Fuji River basin using GSMaP bias-corrected in multiple ways and the BTOP model for runoff simulation. The results found that well-placed ground rain gauges play an essential role in using satellite rainfall products, even in small basins. The results were published in an international journal. The application of corrected GSMaP to flood inundation analysis in Myanmar was also published in a national journal. Also developed components for application to RRI and other models and embedded some of them in analytical models to analyze the basins in West Africa and Davao.
	Improve the accuracy of the WRF model for heavy rainfall prediction using X- and C-band MP radars and the Ensemble Kalman filter.	Improve the prediction accuracy for hard-to-predict phenomena such as rain fronts and localized heavy rains by evaluating possible effects that may be caused by increasing the number of ensemble members and the coverage and resolution of meteorological models, as well as by changes in other factors.	① Overall evaluation 〔 A 〕 ② Publication 〔 B 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 B 〕	Continued studying how to improve rainfall forecasting accuracy by conducting data assimilation experiments using the ensemble Kalman filter and a large number of ensemble members for a 2015 torrential rainfall event caused by a line-shaped rainband. The assimilation system was developed and ported to the supercomputer of the University of Tokyo. The data assimilation experiments with 100 ensemble members confirmed an improvement in rainfall forecast accuracy. Experiments with 1000 ensemble members have started using an updated covariance inflation method to further improve forecasting accuracy.
	Develop a method for real-time flood inundation forecasting using multiple rainfall forecasting approaches with prediction uncertainty.	Conduct real-time flood inundation forecasting, while considering uncertainties, for river basins in Japan and overseas by inputting ensemble rainfall forecasts to the flood inundation model in real time.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	Performed ensemble dam inflow prediction for a warm-season flooding event at a TEPCO dam site in the upper reach of the Sai River basin. Simulations were conducted to estimate dam inflow at Ikusaka Dam during the September 2018 typhoon by inputting ensemble rainfall predictions (3km spatial resolution; 39 hours ahead; hourly temporal resolution; 32 ensembles) to the WEB-DHM-S. As a result, the ensemble mean inflow predicted the flood discharge (800m3/s) at Ikusaka Dam with lead times of 7 to 31 hours. More than 28 ensemble inflows also predicted the flood discharge. The results were published in the annual journal of hydraulic engineering, JSCE.
(i)-(b)-2. Development of technologies using satellites and sediment hydraulic models for assessing the impact of water disaster hazards	Estimate sediment transport and develop an estimation method of river channel topography change.	Verify a new sediment transport evaluation method for usefulness by using it for the analyses of two-dimensional flood flows and riverbed changes in rivers. The method was developed last year to analyze the behavior of fine sediment by applying the entrainment theory to density currents.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 S 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	Programed a new method designed to evaluate fine sediment behavior using the theory of density stratified flow in order to analyze 2D flood flow and riverbed deformation. The program was used to conduct flood flow analyses of the 2017 Akatani River flood and the 2019 Gofukuya River flood. It was also used to analyze the flow conditions of the Jamuna River in Bangladesh. Comparing the results of the sediment and riverbed variability analyses with the actual conditions, we found the method useful for sediment/riverbed variability analysis in rivers where fine sediment is dominant. The results on the Gofukuya River were published in the Journal of Hydraulic Engineering of the Japan Society of Civil Engineers.
	Develop a flood damage risk mapping method that	Carry out detailed analyses of two-dimensional flood flows and riverbed changes, using the methods developed last year for the disasters such as the Kuma River flood in 2020. In particular,	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕	Conducted detailed analyses of 2D flood flow and fluvial deformation for disasters such as the 2017 Akaya River flood, the 2019 Gofukuya River flood, and the 2020 Kuma River flood. The results revealed that sediment

		takes sediment hydraulic phenomena into account.	closely analyze riverbed changes in river channels, and propose a quantitative evaluation method for inundation risk due to riverbed rise.	③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	deposition is particularly severe in areas with relatively small bed shear stress in the longitudinal direction of the river channel, and that there is a high risk of flooding upstream of such areas. The results also showed that when inundation occurs with large amounts of fine sediment, the sediment accumulates in areas with relatively small shear stress, causing the floodwaters to flow through a narrower area with a faster velocity. The results of the Gofukuya River analyses were published in the JSCE Journal of Hydraulic Engineering.
		Develop a method for mapping flood inundation risk in mountainous rivers	Apply the prototype of the model, developed last year to estimate the sediment runoff in the entire basin during a heavy rain event, to river basins such as Oi and Kurobe rivers and verify it using the sedimentation data of the dams. Also create estimated flood inundation maps for these river basins.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 B 〕	Developed a model for estimating sediment runoff in a basin during heavy rainfall events by combining a rainfall-runoff model and a river channel model. The new model was applied to several dam basins in the Oi River, and its usefulness was demonstrated by comparing the simulation results with the actual sediment deposition in the dam. By combining the model with 2D analysis, a method for creating flood inundation area maps for mountainous rivers was also developed. A paper on the Oi River case has been submitted to "39th IAHR World congress" and accepted.
(c) Assessment and planning technology for appropriate water resources management with insufficient information					
	A long-term water balance simulation technology will be developed to support optimal planning of water resources management both in Japan and overseas. This technology will offer a variety of functions to support highly technical dam operation integrating flood control and water use, water demand settings, soil moisture content settings based on satellite observation technology, application to a wide range of climate categories, input of highly detailed topographical, geological and other data.				
	(i)-(c)-1. Development of a simulation system to provide long-term support for integrated water resources management under different natural and topographical conditions	Improve technologies for integrated water resources management.	Carry out water balance simulation by incorporating short-term rainfall forecasts (39 hours) and seasonal precipitation forecasts (1 month/3 months) and study highly optimized dam operations for flood control and water use, such as preliminary dam release and snowmelt flood control.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 A 〕 ⑤ Dissemination 〔 A 〕	Tested an optimized dam operation method for flooding in the warm season (July-October) at a Chuden dam site in the upper Oi River basin by considering the width of ensemble-predicted inflow. The optimized dam operation method was applied to flooding events at Hatanagi Daiichi Dam caused by typhoons in September 2018 and October 2019 by inputting 32 ensemble rainfall predicted 39 hours ahead to WEB-DHM. In the case of the September 2018 event, pre-releases of dam water were performed. As a result, the simulated dam water level decreased, and the simulated peak flow was successfully controlled to remain below the 600 m3/s level. In the case of the October 2019 event, because the dam storage level was low at the forecasting start time, the dam stored the inflow effectively up to the full storage level, and the gate discharge was successfully controlled to remain below 600 m3/s. According to the Power Generation Volume Index, the average power generation during the warm season (July to October) showed a 12.8% increase in 2018 and a 3.7% increase in 2019. The results were published in the annual journal of hydraulic engineering, JSCE.
		Study soil moisture content based on satellite data.	Study a method to use soil moisture content and other factors, obtained from satellite remote sensing and data assimilation methods, in hydrological runoff modeling in order to improve the applicability to water resource management analysis.	① Overall evaluation 〔 A 〕 ② Publication 〔 A 〕 ③ Scientific significance 〔 A 〕 ④ Social significance 〔 S 〕	Improved the microwave radiative transfer model (RTM) based on experimental field observations using ground-based microwave radiometers. Conducted a drought monitoring study in West Africa using the RTM as the core component of the CLVDAS, and the results were published in an international journal. Applied CLVDAS to estimate soil moisture content and vegetation water content in farmland in Jordan. The results confirmed the consistency with

			⑤ Dissemination [A]	the tomato yield, a primary agricultural product of the country, which ensured the wider applicability of CLVDAS to different regions. Studied a yield estimation method for major crops grown in all municipalities of the Banabuiú River basin of Ceará State in Brazil. Estimated leaf biomass while assuming that it had absorbed soil moisture optimized by CLVDAS and fed it to a model built by combining WEB-DHM and a dynamic vegetation model with high spatial resolution.
	Improve the applicability of systems and models to rivers in Japan and overseas with different climate conditions.	Study the combination of more advanced evapotranspiration and snowmelt models with runoff analysis models to expand the applicability to river basins with different climate and land conditions.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [S] ④ Social significance [A] ⑤ Dissemination [A]	Developed and validated a model coupling WEB-RRI, SIMRIW, and Dynamic Vegetation Model to evaluate accurate evapotranspiration. The model was applied to the Pampanga River basin to estimate the rice crop yield. The model will be improved further by introducing ground and satellite data on crop calendars, planting dates, and irrigation. Developed a model by coupling the WEB-DHM model and a snow-fall/snow-melt runoff model, which can be used for real-time prediction, and validated it in the Oi River basin and the Sai River basin.
(i)-(c)-2. Integrated Research Program for advancing Climate Models (TOUGOU) (MEXT program)	Assess water disaster risk in Asia and create information on adaptation measures.	Continue the ongoing projects in Indonesia and the Philippines to produce future precipitation information using a dynamic downscaling method and estimate flood and drought damage risks using WEB-RRI by collecting data and information on topography, past inundation areas, land use, water use, etc., in cooperation with local researchers and government officials. Also develop and introduce OSS to support local experts in the implementation of climate change adaptation measures.	① Overall evaluation [S] ② Publication [A] ③ Scientific significance [A] ④ Social significance [S] ⑤ Dissemination [S]	Conducted dynamic downscaling of future precipitation data for the Solo and Davao river basins using the MRI-AGGM3.2S/3.2H model and future climate scenarios of RCP8.5 and 2.6. Also developed a WEB-RRI model in each basin, simulated hydraulic and hydrological phenomena using future precipitation data, and conducted risk assessment of floods and droughts considering land use in the basin. Constructed and introduced OSS-SR to support Davao in implementing climate change adaptation. Using this system for e-learning, Facilitators were trained through a one-month workshop and two-week practical training. A human resources development program was also conducted in Indonesia primarily to strengthen cooperation between related ministries and agencies. These achievements were widely reported at the TOUGOU Report Meeting (February 3, 2022), and the Area Theme D “Integrated Hazard Prediction” Public Symposium (January 20, 2022).
(d) Technology for assessing the impact on local communities of water related disasters in flood plains and for evaluating the effect of investments in disaster risk reduction				
A disaster risk assessment method will be developed to evaluate “strength against fatal damage” and “resilience for speedy restoration”. Indices will be proposed to help policy makers in Japan and overseas easily recognize local disaster risks and holistically evaluate the effect of investments on disaster risk reduction so that they can make informed investment decisions. A method will be proposed for building disaster resilient communities in Japan and overseas by using the developed risk indices.				
(i)-(d)-1. Research on a multifaceted water disaster risk assessment for worldwide use and a disaster-resilient community building method based on the assessment	Propose a highly accurate and advanced method for multifaceted evaluation of disaster risk	Establish an advanced risk estimation method considering the relationship between damage and resilience according to business type, inundation depth, lifeline utility damage and other factors, based on the results of the investigations conducted in Joso City after the Kanto-Tohoku heavy rain disaster in September 2015 and in Hiroshima and Okayama prefectures after the heavy rain disaster in July 2018. Upgrade the risk estimation method to factor in damaged parts of a house and inundation depth, based on the results of the	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Analyzed the impact of disasters on the production and sales of business establishments. The results revealed the relationship between the presence or absence of direct and indirect damage and the days of business suspension. This research prompted the revision of the Flood Damage Economical Survey Manual in 2020.

		investigations conducted in Joso City after the Kanto-Tohoku heavy rain disaster in September 2015 and in Iwaizumi Town, Iwate Prefecture, after Typhoon No.10 in 2016.		
	Propose risk indices to holistically evaluate the disaster risk reduction effect of disaster prevention measures and investments	Propose an index capable of holistically evaluating flood damage to help determine whether communities can maintain themselves even after a disaster. The index will be devised from estimated population outflow rates calculated based on an investigation which asked disaster-affected residents in Iwaizumi Town, Iwate Prefecture, whether or not to relocate to other places. Also propose an index focusing on the damage level at which the pre-disaster regional gross product can be maintained, based on data on changes in the regional gross product of municipalities after past flood disasters.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Examined the recovery curve of housing reconstruction, daily life, and community activities in the affected areas after a disaster.
	Propose a method for building disaster resilient communities in Japan and overseas by using the developed risk indices.	Study measures to build the resilience of local communities to possible hazards, based on the evaluation index proposed above.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Proposed indicators, such as the period that communities may need to achieve a 50% recovery, as the targets for planning and investing in disaster risk reduction measures, based on the recovery curve of housing reconstruction, daily life, and community activities in affected areas after a disaster. Also proposed possible recovery promotion measures, including how to shorten this 50% recovery period.
(e) Technology for the effective use of water related disaster risk information to reduce disaster damage				
An information system, as well as communication tools such as disaster response timeline tables, will be developed to support disaster management efforts by administrators and local residents to prevent or mitigate flood and sediment disasters. The effective use of such a system and tools will be proposed.				
(i)-(e)-1. Research on a water disaster risk information delivery system to support local disaster management efforts in areas with insufficient water disaster information	Propose a method for identifying areas vulnerable to disasters (disaster hot spots) prior to disasters.	Apply the developed flood risk assessment tool to other municipalities (e.g., Tsukuba City).	① Overall evaluation [A] ② Publication [B] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [B]	Applied the developed flood risk assessment tool to Aga Town, Niigata Prefecture, and Iwaizumi Town, Iwate Prefecture.
	Propose a method for forecasting the possibility of a water-related disaster by community in real time.	Conduct a demonstration experiment using the ICHARM Disaster Risk Information System (IDRIS) developed as a Web-GIS information delivery system in the previous year. Also link IDRIS with short-term flood forecasts for small and medium rivers on DIAS.	① Overall evaluation [A] ② Publication [B] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [B]	Linked PRISM, a flood forecasting tool for small and medium rivers, with IDRIS, a disaster risk information system developed on DIAS in the previous year.
	Propose a Web-GIS water-related disaster risk information delivery system that helps	Improve IDRIS for more stable operation by routinizing its maintenance. Also update IDRIS to enhance its usability with recent WEB technologies and smartphones.	① Overall evaluation [A] ② Publication [B]	Improved IDRIS, which solely depended on a specific system, to be compatible with recent WEB technologies and smartphones, and conducted case studies using IDRIS in Aga Town, Niigata Prefecture, Iwaizumi Town, Iwate Prefecture, and Tsuruoka City, Yamagata

	accumulate and share various types of disaster risk information and deliver evacuation information.	Develop a new system to help optimize resources for water-related disaster response by sharing experiences and knowledge of water-related disaster response during and after the COVID-19 pandemic. This will be realized by coupling IDRIS on DIAS with BOSS and SHIFT.	③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [B]	Prefecture. Additional improvements were made to IDRIS by adding the information and functions of critical situations during flood emergency response, BOSS and SHIFT.
	Propose the effective use of the Web-GIS information delivery system to stakeholders of local administrative bodies in Japan and overseas.	Improve the Web-GIS information delivery system into the one capable of assisting local governments in sharing information that contributes to their efforts in disaster prevention and mitigation by promoting cooperation among local disaster prevention officers in Japan and the IFI implementing countries.	① Overall evaluation [A] ② Publication [B] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [B]	Improved IDRIS in collaboration with local governments (Aga Town, Niigata Prefecture, Iwaizumi Town, Iwate Prefecture, and Tsuruoka City, Yamagata Prefecture) into a system that assists them in sharing information for better disaster prevention and mitigation. Constructed OSS-SR, a disaster prevention information sharing system, for the Davao River (Philippines), the Pampanga River (Philippines), and the Kalu River (Sri Lanka) in IFI-related countries.
(i)-(e)-2 Development of risk communication systems to increase public awareness of water-related disasters and risk management	Develop a DIAS-based simulation system that can seamlessly reproduce, predict and visualize meteorological and hydrological events and related damage.	Apply the high-end VR developed for Hita City, Oita Prefecture, to the city and other areas. Continue to conduct activities related to Aga Town, Niigata Prefecture: collect detailed spatial information by conducting surveys using drones and ground laser instruments; reproduce inundation events using the RRI model and the sediment-driftwood-inundation model; and integrate collected data and information using the Construction Information Modeling (CIM). Also create a preliminary version of VR flood contents based on collected information to share flood experiences as well as record and hand down past events, experiences and knowledge to future generations.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [S]	Developed a virtual flood experience system using avatars after reproducing inundation situations using the RRI model and a flood inundation model based on the spatial information collected in Aga Town, Niigata Prefecture, using UAV, ground laser survey and photogrammetry. Also conducted a technical study to seamlessly read the XML data placed on DIAS. Experimentally created flood VR contents to record and pass on past water disasters to the next generation.
	Develop a more effective risk communication system by incorporating psychological factors.	Identify prime determinants influencing people's psychological change and behavioral choice during evacuation by conducting experiments to observe evacuation behavior in a virtual flood event. The experiments will be conducted using a virtual evacuation drill tool developed in the previous year that allows several people to experience a virtual flood event at once using a cloud service. Also improve the IDRIS application to be a comprehensive flood risk communication tool by coupling the application with the VR evacuation drill tool.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [S] ⑤ Dissemination [S]	Evaluated the virtual flood experience system by comparing the simulated and actual flood situations of Typhoon No. 19 in 2019 with help from affected residents. The results showed that when deciding to evacuate, the residents referred to their experience of past floods (2011 Niigata, Fukushima heavy rain, etc.). The results also pointed out that people should know that experience can work against them, especially under climate change. For this reason, the VR tool was designed to pass on lessons that people should learn from past flood events, including the one that it is sometimes wise not to rely too much on experience.
(i)-(e)-3. Local practice using research results	Continue supporting JST-JICA SATREPS, a project to develop an Area-BCM (Business Continuity Management) system to strengthen the disaster resilience of Thailand's industrial parks.	Develop a high-resolution flood inundation analysis model and conduct flood inundation analysis based on multiple flood scenarios for the Rojana industrial park in Ayutthaya Province, Thailand. Develop business impact analysis (BIA) and regional business continuity management (Area-BCM) for the industrial park, using the results of the flood inundation analysis. Also start developing a high-resolution flood inundation analysis model for Bang Pa-in, High Tech and other industrial parks.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Developing methods that can contribute to businesses making decisions about operations and evacuation in case of a disaster by creating a detailed flood analysis model capable of industrial complex-scale simulations based on a basin-scale flood analysis model and predicting when inundation may start and end, which area may be inundated, and how deep the inundation may be.
	JST-JICA SATREPS, The Project for Development of a Hybrid Water-Related Disaster Risk Assessment	Test flood and drought risk evaluation for the basins of the Pampanga, Pasig, Marikina and Lake Laguna in Luzon Island, the Philippines, using a model developed by coupling the WEB-RRI model with SIMRIW, a crop-growth prediction model. Conduct test runs of simple calibration using satellite images since model	① Overall evaluation [S] ② Publication [B] ③ Scientific significance	Managing the ongoing joint research project with the Philippines. A kick-off meeting was held online on June 30, 2021, and a joint coordination meeting (JCC) was held online on November 17, 2021, and attended by the participating organizations of Japan and the Philippines. Conducted e-learning training in July-August 2021 regarding water disaster risk

		Technology for Sustainable Local Economic Development Policy under Climate Change in Philippines (new project)	calibration using local data is impossible due to the COVID-19 pandemic. Evaluate the post-disaster resilience of areas affected by Typhoon Ulysses (No.22), which made landfall on November 12, 2020, using data already available for the public and data available even under the pandemic and compare the areas' resilience to Typhoon Ondoy in 2009 and Typhoon Pedring in 2011.	[S] ④ Social significance [S] ⑤ Dissemination [S]	assessment methods. Out of 83 participants, 49 submitted the assignments and completed the training. Held a public webinar on November 5, 2021, which marked one year after the disaster on November 12, 2020, caused by a giant typhoon, Ulysses, which crossed Luzon Island during preparations for a local project, devastating the project area of Luzon Island's Pampanga River basin, the Pasig Marikina River, and the Laguna lake basin. The webinar gathered 243 people and disseminated the results of the research project. ICHARM presented an online system that comprehensively visualizes the damage in each municipality using Google Earth Engine based on the inundation area estimated from satellite images and damage reports.
(ii) Effective Capacity Development					
(1) Train solution-oriented practitioners and Training-of-Trainers (TOT) instructors with solid theoretical and engineering competence who will contribute effectively to the planning and practice of disaster risk management at local and national levels.					
	(ii)-(1)-1. Capacity development for professionals who can train and supervise local researchers	Doctoral Course "Disaster Management"	Accepts 2-3 people (2021-2022).	① Overall evaluation [S] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Evaluated eight Ph.D. applicants for research abilities and accepted three students from three countries (the Philippines, Sri Lanka, and Nepal) in October 2021. Currently, five people from five countries (Ethiopia, Bangladesh, Sri Lanka, Nepal, and the Philippines) are studying in the doctoral program. Graduated three students from three countries (Japan, Sri Lanka, and Vietnam) in September 2021. They are now back home, contributing to the development of science and technology and human resources in their countries. Prepared a training and supervision system to minimize the impact of COVID-19 on our training and research programs. For example, a flexible lecture system has been introduced, in which we flexibly choose different lecture styles from face-to-face, remote, and a combination of the two types, depending on how severely the infectious disease is affecting society.
	(ii)-(1)-2. Capacity development for experts with practical solutions to local problems on water-related disasters	Master's Course "Water-related Disaster Management Course of Disaster Management Policy Program"	For 2021-22, we will accept about 14 people from the target countries decided based on the results of each country's request survey. Inform relevant countries of the thorough submission of English proficiency qualifications at the time of application	① Overall evaluation [S] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Graduated seven students from six countries (one each from Bangladesh, Malaysia, Mauritius, Myanmar, and Tonga; two from Bhutan) in September 2021. Unfortunately, two participated in the lectures and research supervision online throughout the year due to COVID-19. However, one of those two received the Best Research Award, which is given to those who have created an excellent master's thesis. The program was managed fairly well, even under unusual circumstances. Accepted 13 students from eight countries (one each from Bhutan, Indonesia, Malawi, and Nepal; two each from Bangladesh, Malaysia, and the Philippines; three from Sri Lanka) in October 2021. As with those who graduated in September 2021, the new students have had to endure the inconveniences caused by COVID-19 in lectures and research plans, e.g., about half of the lectures were conducted online. However, the training and supervision system has been improved to cope with this situation. For example, a flexible lecture system has been introduced to choose a different lecture style from face-to-face, remote, and a combination of the two types, depending on how severely the infectious disease is affecting society.

(ii)-(1)-3. Days- and weeks-long training to learn knowledge and technologies for water-related disaster risk management	Short-term training	Conduct lectures and exercises in cooperation with JICA-sponsored thematic training "Measures for Mitigating Water Disaster Damage". Training for FY2020 will be conducted online from May 26-28, 2021.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Conducted the training online in May 2021 due to the spread of the COVID-19 infection. Although operated remotely, the training went well and was fruitful because both the instructors and participants had improved their remote conversation skills.
	Hold follow-up seminars for ICHARM master's program graduates and others.	Visit one country and hold follow-up seminar. (We will also consider holding a web seminar for multiple countries about once every four years.)	① Overall evaluation [S] ② Publication [S] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Held an online follow-up seminar for 172 master's and doctoral degree holders in 35 countries (as of September 2021) on February 25, 2022. The seminar aimed to share the issues faced by each country and alumni, seek solutions, strengthen the network of human resources and science and technology, and obtain information for ICHARM to improve its research and educational programs in quality and quantity. Over 100 people participated, including current students and ICHARM researchers. The purposes of this seminar were fully achieved.
(2) Build and strengthen a network of local experts and institutions involved in water-related disaster management by providing knowledge and skills accumulated from research and local practice for training in international projects and ICHARM's educational and training programs.				
(ii)-(2)-1. Follow up and encouragement for ex-trainees	Hold workshops in ex-trainees' countries.	Create and maintain trainees list. Using Facebook, build a network of trainees and provide training activities information. Hold a follow-up seminar.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Continued creating and updating the trainees' list and building a network. Also continued managing Facebook pages, updating a dozen times a year.
(iii) Efficient Information Network				
(1) Collect, analyze and disseminate the records and experiences of major water-related disasters around the world as the comprehensive knowledge center for practitioners.				
(iii)-(1)-1. Collection and organization of disaster-related records and documents	Promote collaboration with other organizations and collect water disaster information.	Develop a framework for the efficient collection of water-related disaster information which support, for example, assessing and evaluating the socio-economic impact of flood disasters using big data processed by DIAS, and promote the sharing and effective use of the collected information.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Promoted the integration and archiving of the hazard data of water-related disasters using DIAS. Continued to collect rainfall and other data in real time from various countries, including the IFI implementing countries such as the Philippines and Sri Lanka, and studied ways for the further utilization of such data for flood management.
(iii)-(1)-2. Collaboration with other organizations	Promote the collaboration with other organizations and collect water disaster information.	Promote the collaboration for collecting abundant, reliable disaster information with international organizations (WMO, UNDRR, etc.), the University of Tokyo and its DIAS project, and other UNESCO Centres and Chairs.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance	Actively participated in web meetings to collect information on global trends and water-related disasters from other UNESCO Centers and Chairs and international organizations, and strived to establish partnerships with participating organizations. Co-organized an information session of WADiRE-Africa, a joint project with UNESCO, in December 2021 in partnership with UNESCO and

			Strengthen the collaboration with water-related disaster management agencies of each country through an IFI Platform on Water Resilience and Disasters.	[S] ⑤ Dissemination [S]	AGRHYMET. In this session, the ambassador, permanent delegate of Japan to UNESCO, gave an opening address, and an expert from VBA, who had training at ICHARM for the WADiRE-Africa project, spoke as a panelist. In close cooperation with WMO, participated in the SBP Fora of the APFM and contributed to the development of flood early warning systems in the Volta River basin. Promoted DRR as a key member of JHoP, a unique entity composed of prominent universities, research institutions, and public associations involved in disaster resilience enhancement in Japan in order to contribute to the creation of disaster-resilient societies. Organized the S&T Panel as part of UNSTSWD5 held online on June 25, 2021. The panel was joined by more than 160 viewers worldwide.
(2) Mainstream disaster risk reduction by disseminating knowledge and technology for water-related disaster risk management and building and maintaining a worldwide influential network such as IFI.					
	(iii)-(2)-1. Collaboration with relevant organizations	Fulfill the duties as the IFI secretariat.	Carry out the responsibilities as the IFI secretariat in collaboration with the participating organizations, including reviewing the concept of IFI and other issues at the Advisory Committee meeting at the opportunity of ICFM8 scheduled in August 2021 and holding periodical Management Committee teleconferences. Continue efforts to disseminate IFI activities at various major international conferences such as ICFM8 and AOGEO and in collaboration with relevant organizations such as ADBI. Promote the partnership with the IFI implementing countries and relevant organizations.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Shared information with UNESCO and the IFI participating organizations by continuously organizing web meetings. Convened the AWCI Session online on October 29, 2021, as a sectional meeting of the 14th AOGEO Symposium. More than 50 people participated from the Philippines, Sri Lanka, and Indonesia. The session also covered cutting-edge research and development topics in agriculture and food, climate change and water use, ecosystem-based disaster risk reduction, and floods and poverty. The results were reflected in the statement of AOGEO. Eagerly engaged in preparations for ICFM9 in February 2023 as the conference organizer in close partnership with relevant organizations, and planning to hold IFI-related meetings at this opportunity.
		Support local efforts led by IFI.	Support the Philippines, Myanmar, Sri Lanka, and Indonesia in establishing the Platforms on Water Resilience and Disasters, developing the implementation plans, and promoting related activities based on them. Continue efforts to expand IFI activities to other Asian countries, Africa and Latin America. Promote e-learning for engineers and other experts engaged in water-related disaster management and study issues toward developing the Online Synthesis System (OSS) and fostering Facilitators in collaboration with relevant organizations.	① Overall evaluation [S] ② Publication [A] ③ Scientific significance [A] ④ Social significance [S] ⑤ Dissemination [S]	Documented the outcomes of the Platform activities, and discussed and developed future activity plans in collaboration with the relevant organizations of the IFI implementing countries. Developed OSS-SR on DIAS and used it to provide an e-learning program for "Facilitators" training conducted for about a month from April 19 to May 17, 2021, on the Davao River basin in the Philippines. Conducted an e-learning & workshop program from October to November 2021 for government officers in Indonesia in collaboration with the governmental, operational, educational, and research institutes of Japan.
		Play a leading role in Typhoon Committee (TC).	Fulfill the duties as the WGH chairperson and promote the AOP7 "Platform on Water Resilience and Disasters under International Flood Initiative" in collaboration with the WGH Members. Enhance collaborative activities for promoting AOP7 with JMA, a WGM Member, and the IFI-relevant organizations of the Philippines. Organize the 10th WGH meeting in Japan in collaboration with MLIT and participate in the 16th IWS meeting and the 54th Annual sessions as WGH chairperson to summarize discussions on typhoon-related disasters in the TC region and contribute to	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Organized the 10th WGH meeting online in October 2021. An ICHARM researcher chaired the meeting, summarized the discussions, and reported the progress of WGH's AOP, "Platform of Water Resilience and Disasters under the IFI." Actively participated in the 16th IWS and the 54th Annual Sessions, which were held online. An ICHARM researcher actively participated, chaired the sessions, and reported the discussions.

		developing and applying effective measures in collaboration with the Members.		
	Japanese Ministry of Foreign Affairs (MOFA) and the International Atomic Energy Agency (IAEA)/Regional Cooperative Agreement (RCA) RAS/7/030 Project on "Assessing Deep Groundwater Resources for Sustainable Management through Utilization of Isotopic Techniques"	Participate in the following activities in response to the request from MOFA to participate in IAEA activities: 1) Participate on behalf of Japan in the interim review coordination meeting of RAS / 7/035 Project to be held in the summer of 2021 and provide the latest information on the research and application of isotopic techniques in Japan in collaboration with Japan's National Project Coordinator (NPC). 2) Participate as an IAEA instructor/expert in the IAEA Home Base Expert Mission held online for the IAEA / RCA RAS / 7/035 Project, and provide online training, advice, and guidance to representatives from three countries such as Mongolia. Also promote efforts in research on the water cycle process using isotopes and other means in connection with the IAEA project.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Continued communication and coordination via emails and videos, though all in-person training sessions and meetings of the IAEA Project RAS/7/035 titled "Enhancing Regional Capability for the Effective Management of Ground Water Resources Using Isotopic Techniques (RCA)" were cancelled. Regional training was distributed via pre-recorded video lectures, and an ICHARM research specialist provided advice for the Philippines and Indonesia.
(iii)-(2)-2. Synergy effects enhanced by alumni networking	Alumni networking	Continue updating the alumni list. Continue using Facebook to network ICHARM alumni and facilitate the interaction among them, as well as between ICHARM and the alumni. Maintain close contact with the alumni by sending newsletters and other means.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Updated the ICHARM alumni list and used it to maintain the network with them, such as for the announcement of a follow-up seminar in February 2022 and other communication and coordination. Established a Facebook network with ICHARM alumni and facilitated the interaction among them and between ICHARM and the alumni. Maintained the alumni network by including articles contributed by graduates from ICHARM training and educational programs in ICHARM Newsletters.
(iii)-(2)-3. Public relations	Maintain the ICHARM website.	Actively disseminate information on the latest activities on research, training and international networking, as well as on other activities and announcements, by posting them on the website in a timely manner. Continue to improve the newsletter contents based on the viewers' feedback. Reply to comments and inquiries from the viewers quickly and appropriately.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Updated the website with the latest information, including newsletters and research activities. Continuously operated an inquiry/comment section for the viewers and replied to them as soon as possible.
	Publish the ICHARM newsletter.	Publish the newsletter four times a year (January, April, July and October), and include various articles about ICHARM activities that are current and informative. Enrich and diversify the newsletter contents by promoting activities on research, training and international networking and collecting contributions from partner organizations and educational and training program graduates, including feedback from the subscribers.	① Overall evaluation [A] ② Publication [A] ③ Scientific significance [A] ④ Social significance [A] ⑤ Dissemination [A]	Continued to be active in public relations by publishing quarterly newsletters for as many as 5,000 readers, on which a wide range of ICHARM's latest activities are reported. Started an online survey since No. 60 of April 2021 to further improve the contents. More efforts have been made to diversify news topics by collecting disaster-related contributions, such as the damage caused by Typhoon Hagibis in 2019, from people outside ICHARM.

ICHARM Work Plan

FY 2022-2023 (2022.4-2024.3)

Mid-term Programme	Contents	Activities and expected results in FY 2022-2023
(1) Innovative research		
1) Data collection, storage, sharing and statistics on water-related disasters		
ICHARM will conduct research on technologies to collect and store data and information regarding hazards, exposure and vulnerability and share them among stakeholders. We will also actively support nations and communities in data collection, storage, and sharing by developing and helping them implement technologies to collect damage data that can be operated by themselves. Technical assistance will also be provided for nations to compile highly reliable statistical data.	Support runoff inundation analysis using global observation data (Philippines, Argentina).	Improve the system continuity of the runoff inundation analysis system in the Philippines' Pampanga River basin by applying satellite rainfall data to prevent the system from disruption due to undelivered rain gauge data. Also, develop tools to support the implementation of a series of correction processes using ground rain gauge data. Provide support for Buenos Aires, Argentina, and other cities to introduce the improved system and tools.
	Improve the resolution of soil moisture observation using global observation data.	Improve the resolution of land surface information (soil moisture content and vegetation biomass) up to about 1 km by combining a data assimilation system (CLVDAS) and a water energy balance model, apply the information system to different areas, and verify its effectiveness. Strive further to increase the resolution up to 100m by additionally using the synthetic aperture radar (SAR). Also, develop a model by combining CLVDAS and WEB-RRI-Veg for West Africa to establish drought monitoring
	Develop OSS-SR (Online Synthesis System for Sustainability and Resilience).	Develop and improve OSS-SR, accumulate water disaster statistics and other data, and build a data platform on DIAS while raising public awareness of water disaster prevention and providing facilitator training in the Philippines, Indonesia, and other countries. Select and coordinate target cities in Japan to carry out the same activities and start developing OSS-SR.
	Develop an information platform on which various types of information can be used on digital twins.	Start developing a methodology to create a platform for information sharing among related stakeholders while integrating different kinds of information on digital twins, including the specifications of ground conditions and artificial structures, urban development plans related to water-related disaster management, and data on agriculture, natural environment, and past disasters. The Shirakawa River basin in Kumamoto Prefecture is one of the candidates for this study.
2) Risk assessment on water-related disasters		

ICHARM will develop and verify a method to combine water-related disaster assessment models with other models. We will also develop an index that can holistically indicate the basin-wide impact of water hazards. Case studies on the risk assessment of water-related disasters will be conducted at multiple locations both in and outside Japan while taking local conditions into account. Necessary assistance will be provided for local communities to perform risk assessments based on their needs and circumstances using the findings of the case studies, thereby achieving disaster risk reduction.	Upgrade future climate prediction technology using multiple models, downscaling GCMs, etc., and evaluate its regional applicability.	Examine methods for reproducing past heavy rainfall events on meteorological models and methods for estimating the severity of heavy rainfall events due to global warming. Propose an evaluation method for estimating the maximum rainfall suitable for regional meteorological characteristics, estimate the maximum rainfall using multiple methods, compare and verify the estimation results, and propose a valid evaluation method.
	Construct a water cycle model that can take into account basin characteristics and visualize the effects of community-led basin management measures.	Develop an elaborate water circulation model that can physically take into account the basin's conditions and flood control measures, aiming to simulate the effectiveness of individual facilities and structures in flood damage mitigation. Also, develop a model to evaluate the impact of levee breaches.
	Develop, upgrade, and apply hazard assessment of sediment, driftwood, and flood inundation in Japan and abroad.	Focusing on rivers in Bangladesh and Nepal, analyze the mechanism of inundation involving floodwaters, sediment, and driftwood, which occurs as a result of changes in stream channel bed and the volume of suspended sand and driftwood from the upstream end boundary, and evaluate the hazard's uncertainties associated with those factors. Also, evaluate numerical models for their reproducibility of channel fluctuations and study the need to introduce new factors such as lateral erosion to improve the reproducibility.
	Study adaptation measures using integrated risk assessment methods.	Develop and apply a model created by integrating WEB-RRI and SIMRIW (Simulation Model for Rice-Weather Relationships) to basins with various land uses, such as those in the Philippines and Indonesia. Using this integrated model, develop quantitative risk assessment methods that can take into account water-related hazards under future climate scenarios and their direct and indirect impacts. Support local governments in conducting practical activities using risk assessment methods and starting discussions on measures to build a society resilient to water-related disasters.
	Develop a risk assessment model for water disasters that takes into account the linkage among deferent fields.	Study the relationship between water disaster risks and other fields, such as agriculture and city planning, and the possibility of combining models created in different fields. The candidates for this study include the Shirakawa River basin in

			Kumamoto prefecture (urban area) and the Omoto River basin in Iwate prefecture (mountainous area).
3) Monitoring and prediction of changes in water-related disaster risk			
	ICHARM will develop, verify and improve methods for monitoring and forecasting changes in hazards due to meteorological conditions with different temporal scales ranging from season to climate change and changes in exposure and vulnerability due to social development and economic changes. These methods will be applied to case studies at multiple locations both in and outside Japan, and the outcomes will be used to provide support for all stakeholders to select appropriate methods according to their needs and conditions to mitigate future risks of water-related disasters by themselves. The methods will be modified with various local adjustments and compared with each other for further improvement to eventually become globally applicable.	Improve the accuracy of forecasting technology for multi-day-scale rainfall and flood events.	Improve the accuracy of rainfall and flood forecasting up to several days in advance. To this end, the data assimilation method will be upgraded using the WRF (Weather Research and Forecasting model)-LETKF (Local Ensemble Transform Kalman Filter) model, and the initial values of atmospheric and terrestrial water circulation forecast models will be improved.
		Develop a water circulation model that can represent low to high water, including the effects of seasonal and regional factors such as snow accumulation and snowmelt.	Apply the inflow forecasting model studied for the typhoon-caused flood events in the Oigawa River (2018, 2019) and the Saigawa River (2018) to typical typhoon flood events in other years to verify its accuracy. Also, apply the model to flood events caused by frontal rainfall to verify the accuracy of inflow forecasting in events with different rainfall patterns. In addition, develop water circulation models for other basins, such as the Tone River basin.
		Evaluate changes in exposure and vulnerability due to social changes.	Monitor the exposure and vulnerability of communities to water disasters, and analyze and evaluate risks associated with changes due to development and other social and economic conditions in the Philippines and Thailand.
4) Proposal, evaluation and application of policies for water-related disaster risk reduction			
	When developing policies that are practical under climate change, it is essential to consider stakeholders’	Develop OSS-SR for building a basin-wide consensus and nurturing facilitators.	Continue developing Area-BCM in industrial clusters and create scientific knowledge that will contribute to policy-making for mitigating water disaster risks in cooperation with related organizations in Thailand.

	understanding of disaster risk reduction measures, lifestyles, socio-economic activities, and possible changes in disaster risks. To achieve these, ICHARM will develop models to evaluate each policy's outcomes and socio-economic assessment methods applicable to different nations, as well as provide training for strengthening human resources to lead local consensus building and political decision making.	Develop technologies to support the effective implementation of "River Basin Disaster Resilience and Sustainability by All".	Develop a method for assessing the economic impact of floods under climate change by utilizing the basin space created on digital twins and explore its applicability to the policy-making process for town development. Tsuruoka City, Yamagata Prefecture, is one of the model cases for this study.
5) Support in constructing the applicability of water-related disaster management			
	ICHARM will support local governments and citizens at several locations in Japan and overseas in the implementation of means for effectively sharing information from early warning systems and other sources among administrators and residents to facilitate coordinated disaster responses among different sectors. We will also develop, verify, and help them implement methods for preparing operation continuity plans based on local needs and conditions and improving interoperability during disaster	Support building an early warning system by providing real-time water-level forecasts and information on flooding and other hazards.	Develop a manual to support river administrators in independently developing low-cost, simple models, based on the RRI model developed for small and medium-sized rivers, for forecasting water levels and gathering inundation information with uncertainties. In creating a manual, a test model will be presented before the flooding season, a trial run will be conducted, and the results and feedback will be collected and reflected in the manual to increase the usability of the model.
		Develop optimal operation methods for existing dams and other structures that contribute to flood control and support their implementation in target locations.	Study and test optimal operations for three dams built on a single river (the Takasegawa River, a tributary of the Saigawa River), which was expanded on the basis of the optimal operation using rainfall and flood forecasting developed to enhance the water-use and flood-control functions of a single dam originally built for power generation in the upper Oigawa River. Also, conduct research to prepare for applying this method to reservoirs in the state of Kerala, India.
		Develop technologies (e.g., VR) to effectively provide risk information.	Improve the virtual flood experience system using DIAS and study effective methods to increase its public accessibility with a view to utilizing it in emergency drills and awareness-raising activities conducted by governments and companies.

	response by liking administrative functions effectively at all levels.		Study approaches to promoting broader use of this system among the public, for example, preinstalling it in popular devices and creating applications.
		Compile knowledge for strengthening disaster response capabilities of local governments and other entities.	Revise the "Collection of Critical Situations during Flood Emergency Response (local government edition)" by collecting and organizing new cases from the disaster response review reports released by local governments in Japan from 2017 to 2020. In addition, produce a version for business establishments. Study AI and text mining methods for automating the collection of critical situations, as well as feedback systems from local governments.
		Research response to water disasters and support and enhancement of early recovery.	Develop a system to support preparation for an emergency response to water disasters. The system is built on a disaster risk information system and capable of helping those in charge of disaster management: - confirm what to do when water disaster risks increase, - check what to do and possible critical situations during the response effort in case of disaster, - compile a BCP, - collect and share information on damage and restoration, and - examine how best to allocate personnel and other water disaster response resources.
(ii) Effective capacity building			
1) Foster solution-oriented practitioners and Training-of-Trainers (TOT) instructors who will contribute effectively to the planning and implementation of disaster management with solid theoretical and engineering competence at all levels from local to international.			
	It is important to increase the understanding and collaboration of all stakeholders in river basins to build resilience and sustainability against increasingly intense water-related disaster risks. ICHARM will foster facilitators who can integrate and translate interdisciplinary scientific knowledge for all	Doctorial Course "Disaster Management"	Accept about 2-3 students every year
		Master's Course "Water-related Disaster Management Course of Disaster Management Policy Program"	Accept about 14 students every year from the countries selected based on the results of the needs survey administered to candidate countries.
		Start preparing for capacity development programs related to water-related disaster	Start preparing for launching an a-month-long training course, tentatively named "Field Integration Course on River Basin Disaster Resilience and Sustainability by All."

	stakeholders to cooperate in building social consensus by employing a cross-sectoral approach in the public sector and encouraging the private sector for active participation.	management policies	This course plans to accept about three trainees each from countries at a high water-disaster risk, who are in charge of river management, risk management, crisis management, or meteorology. They will study Japan's science and technology related to water disaster management in an integrated manner and learn how to organize well-coordinated actions among ministries and agencies across different sections to solve issues regarding water-related disaster management.
2) Train facilitators to acquire interdisciplinary scientific knowledge related to water-related disaster risk reduction and the capability to lead consensus building among various stakeholders.			
	It is important to increase the understanding and collaboration of all stakeholders in river basins to build resilience and sustainability against increasingly intense water-related disaster risks. ICHARM will foster facilitators who can integrate and translate interdisciplinary scientific knowledge for all stakeholders to cooperate in building social consensus by employing a cross-sectoral approach in the public sector and encouraging the private sector for active participation.	Provide e-learning, training, facilitator development through IFI and other networks.	Develop and improve OSS-SR, accumulate water disaster statistics and other data, and build a data platform on DIAS while raising public awareness of water disaster prevention and providing facilitator training in the Philippines, Indonesia, and other countries. Select and coordinate target cities in Japan to carry out the same activities and start developing OSS-SR.
3) Maintain and enhance the capacity of local experts and institutions engaged in addressing water-related risks using accumulated knowledge and skills both in research and practice. ICHARM will support a global network of exemplary practitioners involved in water-related hazard and risk management.			
	Offering opportunities to research and practice water-related disaster management, ICHARM will support the graduates from its educational and training programs to become a leader in promoting water hazard and risk management in their own	Expand a network by holding follow-up seminars for ICHARM master's program graduates and others.	Discuss ways to hold a follow-up seminar overseas in a graduates' country while considering the situation of COVID-19. At the same time, prepare to have a yearly meeting of the online follow-up seminar as we held last year.

localities. The ICHARM alumni network across the globe has been facilitated through follow-up meetings and created knowledge hubs to contribute to water-related risk reduction around the world.		
(iii) Efficient information networking		
1) Accumulate, analyze and disseminate major water-related disaster records and experiences by maintaining and upgrading a worldwide practitioners' network.		
ICHARM, as the global knowledge center for water hazards, will be working closely with the UNESCO IHP, the World Meteorological Organization (WMO), the Typhoon Committee (TC), the International Flood Initiative (IFI), and other domestic and international agencies, exchanging data, information, lessons and ideas regarding water-related disasters. By hosting and organizing International academic meetings, ICHARM will continue offering a place to collect and disseminate the most advanced knowledge for researchers around the world.	Fulfill the duties as the IFI secretariat.	Carry out the responsibilities as the IFI secretariat, including holding regular meetings with the participating organizations, sharing and compiling water-related disaster information, and reviewing the concept of IFI and other issues at the Advisory Committee meeting on the occasion of ICFM9 through coordination with relevant organizations. Continue disseminating IFI activities by participating in major international conferences and projects and strengthening partnerships with relevant organizations. Promote collaboration with relevant organizations to reduce water-related disaster damage.
	Support local efforts led by IFI.	Support the Philippines, Sri Lanka, and Indonesia in establishing the Platforms on Water Resilience and Disasters and promoting related activities based on them. Continue expanding IFI activities to other Asian countries, Africa and Latin America. Promote e-learning for engineers and other experts engaged in water-related disaster management and study issues on developing the OSS-SR and fostering facilitators in collaboration with relevant organizations of the countries participating in IFI activities.
	Play a leading role in Typhoon Committee (TC).	Fulfill the duties as the WGH chairperson, promote AOP7 in collaboration with the Members of WGH and the other working groups and the relevant organizations, and provide support for other related activities. Support Japan and other TC Members in organizing WGH meetings in collaboration with MLIT.

			Participate in IWS meetings and annual sessions as the WGH chairperson to summarize discussions on typhoon-related disasters in the TC region and contribute to developing and applying effective measures in collaboration with the TC Members.
2) Integrate interdisciplinary scientific knowledge into a consilience of water-related risk management as a common asset of practitioners.			
	ICHARM will establish a system to collect accurate data and information by strengthening collaboration with organizations collecting and archiving scientific data, information and knowledge on water-related disasters and nations co-hosting ICHARM's training and research projects. Collected data and information will be sorted out and accumulated as meta-data and integrated into a "consilience of water-related disaster risk management" as a common asset of practitioners.	Collect water-related disaster information and support its accumulation and implementation.	Collect water-related disaster information from relevant organizations in each country through the Platforms on Water Resilience and Disasters under IFI and other regional and international networks. Support local implementation to reduce damage due to water-related disasters through accumulation of such information by using DIAS.
3) Mainstream water-related disaster risk reduction by facilitating active collaboration and communication among experts and organizations through sharing cases and findings in water-related hazard and risk management.			
	ICHARM will continue contributing to worldwide efforts in implementing and mainstreaming disaster risk reduction in step with the Sendai Framework and the Sustainable Development Goals	Organize, participate in or contribute to major regional and international events.	Contribute actively to the 4th Asia-Pacific Water Summit by organizing the thematic session and summarizing discussions and hold the AWCI session of AOGEO and other workshops. Disseminate ICHARM's activities and their outcomes and develop and maintain our networks with participating organizations and experts by organizing technical sessions or providing presentations at major events hosted by UN agencies and

	(SDGs), both adopted in 2015. By enhancing research, capacity building, and networking, we will continue stressing the importance of water-related disaster risk reduction and promoting the creation of a resilient, sustainable society by involving all stakeholders at local, national, and international levels.		regional and international organizations and also by participating in and contributing to regional and international projects. Convene ICFM9 in February 2023 in collaboration with relevant organizations inside and outside Japan, organize a High-Level symposium together with the HELP Secretariat and MLIT, and hold a general symposium open to the public to raise their awareness of water-related disasters.
		Public relations	Keep posting the latest information on the ICHARM website and improve the content based on readers' feedback. Publish the ICHARM newsletter four times a year (January, April, July and October) and keep upgrading its contents to be more interesting and informative for readers. Continue enriching newsletter contents by including more contributions from educational and training program graduates and collaborating experts and by reflecting readers' feedback collected through questionnaires.

AGREEMENT BETWEEN THE GOVERNMENT OF JAPAN AND THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO) REGARDING THE CONTINUATION, IN JAPAN, OF THE INTERNATIONAL CENTRE FOR WATER HAZARD AND RISK MANAGEMENT (ICHARM) (CATEGORY 2) UNDER THE AUSPICES OF UNESCO

The Government of Japan, and The United Nations Educational, Scientific and Cultural Organization,

Recalling that the General Conference at its 33rd Session in 2005 approved the establishment of the International Centre for Water Hazard and Risk Management as a category 2 centre under the auspices of the United Nations Educational, Scientific and Cultural Organization, and that the Agreement between the Government of Japan and the United Nations Educational, Scientific and Cultural Organization (UNESCO) concerning the Establishment of the International Centre for Water Hazard and Risk Management under the Auspices of UNESCO (hereinafter referred to as the "2006 Agreement") was signed in Paris on 3 March 2006,

Considering that the 2006 Agreement expired at the end of the fifth year following its signature, and that the Agreement between the Government of Japan and the United Nations Educational, Scientific and Cultural Organization (UNESCO) regarding the International Centre for Water Hazard and Risk Management (ICHARM) (Category 2) under the auspices of UNESCO (hereinafter referred to as the "2013 Agreement") was signed in Paris on 23 July 2013,

Considering Decision 207EX/16.II of the Executive Board of the United Nations Educational, Scientific and Cultural Organization in 2019 by which the Executive Board decided to renew the status of the International Centre for Water Hazard and Risk Management as a category 2 centre under the auspices of UNESCO and authorized the Director-General of the United Nations Educational, Scientific and Cultural Organization to sign the corresponding agreement with the Government of Japan,

Desirous of defining the terms and conditions governing the framework for cooperation between the Government of Japan and the United Nations Educational, Scientific and Cultural Organization that shall be granted to the said Centre in this Agreement,

HAVE AGREED AS FOLLOWS:

Article 1
Definitions

In this Agreement,

1. "Government" means the Government of Japan.

2. “UNESCO” means the United Nations Educational, Scientific and Cultural Organization.

3. “Centre” means the International Centre for Water Hazard and Risk Management.

4. “PWRI” means the Public Works Research Institute, Japan.

5. “Contracting Parties” means Government and UNESCO.

Article 2
Continuation

The Centre originally established in 2006 in Japan by the 2006 Agreement shall continue under this Agreement. The Government agrees to take, in the course of the year 2020 and within the limits of the laws and regulations of Japan, appropriate measures that may be required for ensuring the continued functioning of the Centre established in 2006 in Japan, as provided for under this Agreement.

Article 3
Purpose of the Agreement

The purpose of this Agreement is to define the terms and conditions governing collaboration between the Government and UNESCO and also the rights and obligations stemming therefrom for the Government and UNESCO, within the limits of the laws and regulations of Japan.

Article 4
Legal Status

1. The Centre shall be independent of UNESCO.

2. The Centre shall be an integral part of PWRI, which enjoys, in accordance with the laws and regulations of Japan, the legal personality and capacity necessary for the exercise of its functions, including the capacity to contract, to acquire and dispose of movable and immovable property, and to institute legal proceedings, in relation to the activities of the Centre.

Article 5
Objectives and Functions

1. The objectives of the Centre shall be to conduct research, capacity building, and information networking activities in the field of water-related hazards and their risk management at the local, national, regional, and global levels in order to prevent and mitigate their impacts and thereby contribute to achieving sustainable development in the framework of the 2030 Agenda for Sustainable Development, promote integrated river basin management, and strengthen resilience to societal and climate changes.

2. In order to achieve the above objectives, the functions of the Centre shall be to:

(a) promote scientific research and policy studies and undertake effective capacity-building activities at the institutional and professional levels;

(b) create and reinforce networks for the exchange of scientific, technical and policy information among institutions and individuals;

(c) develop and coordinate cooperative research activities, taking advantage particularly of the installed scientific and professional capacity of the relevant International Hydrological Programme (IHP) networks, the World Water Assessment Programme, the International Flood Initiative and the relevant programmes of governmental and non-governmental organizations, as well as involving international institutions and networks under those auspices;

(d) conduct international training courses and educational programmes, especially for the policy makers, practitioners and researchers of the world;

(e) organize knowledge and information transfer activities, including international symposia or workshops, and engage in appropriate awareness-raising activities targeted at various audiences, including the general public;

(f) develop a programme of information and communication technology through appropriate data application;

(g) provide technical consulting services; and

(h) produce scientific and technological publications and other media items related to the activities of the Centre.

3. The Centre shall pursue the above objectives and functions in close coordination with IHP.

Article 6
Governing Board

1. The Centre will be guided and overseen by a Governing Board, which will be renewed every three years and will be composed of:

(a) the President of PWRI, as the Chairperson;

(b) a representative of the Government or his or her appointed representative;

(c) representatives of up to three other Member States of UNESCO that have sent to the Centre notification for membership, in accordance with Article 10, paragraph 2, and have expressed interest in being represented on the Board;

(d) representatives of up to five institutes or organizations relating to the activities of the Centre, who shall be appointed by the Chairperson; and

(e) a representative of the Director-General of UNESCO.

The Chairperson may invite a representative of the IHP Intergovernmental Council to participate to the Governing Board meetings.

2. The Governing Board shall:

(a) examine and adopt the long-term and medium-term programmes of the Centre submitted by the Executive Director of the Centre, subject to paragraph 3 below;

(b) examine and adopt the draft work plan of the Centre submitted by the Executive Director of the Centre, subject to paragraph 3 below;

(c) examine the annual reports submitted by the Executive Director of the Centre, including biennial self-assessment reports of the Centre's contribution to UNESCO's programme objectives;

(d) examine the periodic independent audit reports of the financial statements of the Centre and monitor the provision of such accounting records as necessary for the preparation of financial statements;

(e) draw up and adopt any necessary internal regulations of the Centre, based on the relevant legislative and regulatory framework relating to PWRI; and

(f) decide on the participation of regional intergovernmental organizations, international organizations and other interested institutions in the work of the Centre.

3. The long-term and medium-term programmes, as well as the work plan, of the Centre shall satisfy the relevant legislative and regulatory requirements relating to PWRI; they will also be aligned with UNESCO's strategic programme objectives and global priorities, and conform to the Centre's functions as set out in Article 5.2.

4. The Governing Board shall meet in ordinary session at regular intervals, at least once every Japanese fiscal year; it shall meet in extraordinary session if convened by its Chairperson, either on his or her own initiative or at the request of the Director-General of UNESCO or of the majority of its members.

5. The Governing Board shall adopt its own rules of procedure.

Article 7
Staff

1. The Centre shall consist of an Executive Director and staff with experience in research on water hazard and risk management, as well as such staff as is required for the proper functioning of the Centre.

2. The Executive Director shall be appointed by the President of PWRI.

3. The other members of the Centre's staff shall be nominated by the Executive Director for the appointment by the President of PWRI.

Article 8
Contribution of UNESCO

1. UNESCO may provide assistance, as needed, in the form of technical assistance for the programme activities of the Centre, in accordance with the strategic goals and objectives of UNESCO, by:

(a) providing the assistance of its experts in the specialized fields of the Centre; and

(b) including the Centre in various activities which it implements and in which the participation of the latter seems in conformity with and beneficial to UNESCO's and the Centre's objectives.

2. In all cases listed above, such assistance shall not be undertaken except within UNESCO's programme and budget, and UNESCO will provide Member States with accounts relating to the use of its staff and associated costs.

Article 9
Contribution by the Government

The Government undertakes to take appropriate measures in accordance with the laws and regulations of Japan, which may be required for the Centre to receive all the resources, either financial or in-kind, needed for the administration and proper functioning of the Centre. The Centre's resources shall derive from sums allotted by PWRI, from such contributions as it may receive from any governmental, intergovernmental or non-governmental organizations, and from payments for services rendered.

Article 10
Participation

1. The Centre will encourage the participation of Member States and Associate Members of UNESCO which, by their common interest in the objectives of the Centre, desire to cooperate with the Centre.

2. Member States and Associate Members of UNESCO wishing to participate in the Centre's activities as provided for under this Agreement may send to the Centre notification to this effect. The Executive Director of the Centre shall inform the Government, UNESCO and its Member States that have notified their intention to participate in the Centre's activities of the receipt of such notifications.

Article 11
Responsibility

As the Centre is legally separate from UNESCO, the latter shall not be legally responsible for the acts or omissions of the Centre, and shall also not be subject to any legal process, and/or bear no liabilities of any kind, be they financial or otherwise, with the exception of the provisions expressly laid down in this Agreement.

Article 12
Evaluation

1. UNESCO may, at any time, carry out an evaluation of the activities of the Centre in order to ascertain:

(a) whether the Centre makes a significant contribution to UNESCO's strategic programme objectives and expected results aligned with the four-year programmatic period of the Approved Programme and Budget of UNESCO (C/5 document) including the two global priorities of UNESCO, and related sectoral or programme priorities and themes; and

(b) whether the activities effectively pursued by the Centre are in conformity with the functions set out in this Agreement.

2. UNESCO shall, for the purpose of the review of this Agreement, conduct an evaluation of the contribution of the Centre to UNESCO's strategic programme objectives, to be funded by the Centre within annual budgets appropriated thereto and in accordance with the relevant and applicable laws and regulations of Japan.

3. UNESCO undertakes to submit to the Government, at the earliest opportunity, a report on any evaluation conducted.

4. Following the results of an evaluation, each of the Contracting Parties shall have the option of requesting a revision of its contents or of denouncing the Agreement, as envisaged in Articles 16 and 17.

Article 13
Use of UNESCO Name and Logo

1. The Centre may mention its affiliation with UNESCO. It may, therefore, use after its title the mention "under the auspices of UNESCO".

2. The Centre is authorized to use the UNESCO logo or a version thereof on its letterheaded paper and documents, including electronic documents and web pages, in accordance with the conditions established by the governing bodies of UNESCO.

Article 14
Entry into Force

This Agreement shall enter into force upon signature by the Contracting Parties. It shall supersede the 2013 Agreement.

Article 15
Duration

This Agreement is concluded for a period of six years as from its entry into force. This Agreement shall be renewed upon common agreement between the Government and

UNESCO, once the Executive Board made its comments based on the results of the renewal assessment provided by the Director-General.

Article 16
Denunciation

1. The Government and UNESCO shall be entitled to denounce this Agreement unilaterally.

2. The denunciation shall take effect 180 days after receipt of the notification sent by the Government or UNESCO to the other.

Article 17
Revision

This Agreement may be revised by written agreement between the Government and UNESCO.

Article 18
Settlement of Disputes

Any disputes between the Government and UNESCO regarding the interpretation or application of this Agreement shall be resolved through consultations between them.

IN WITNESS WHEREOF, the undersigned, duly authorized thereto, have signed this Agreement.

DONE in duplicate in Paris, this thirteenth day of February, 2020, in English.

For the Government of Japan:
For the United Nations Educational, Scientific and Cultural Organization: