Flood Risk Mapping Project

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in collaboration with
Japan Water Forum and TOKEN C.E.E.Consultants Co.,Ltd.

What is Flood Risk Mapping?

Hazard × Exposure ／Coping Capacity = Risk

Flood Simulation
-Elevation Data
-Precipitation

Climate change

-Land Use data
(Farm land,
Urban(Building,
household, etc.)
-Population data

Societal change

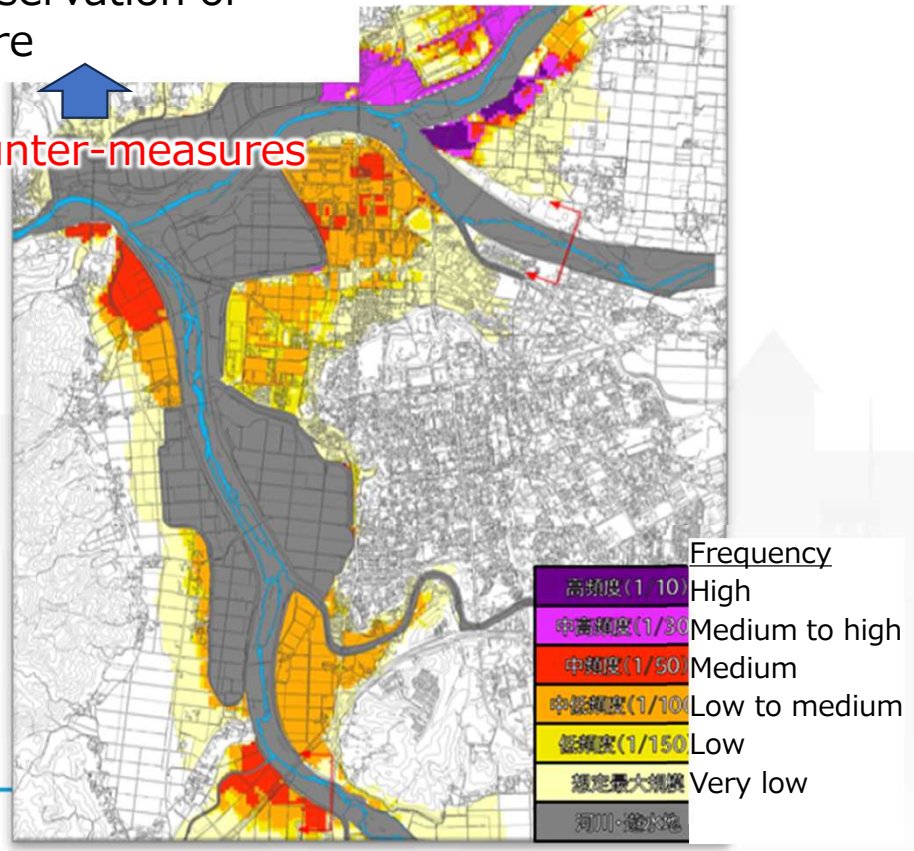
-Flood control facility
(river dike, dam,
retarding basin, etc.)
-Conservation of
nature

Counter-measures

-Potential damage

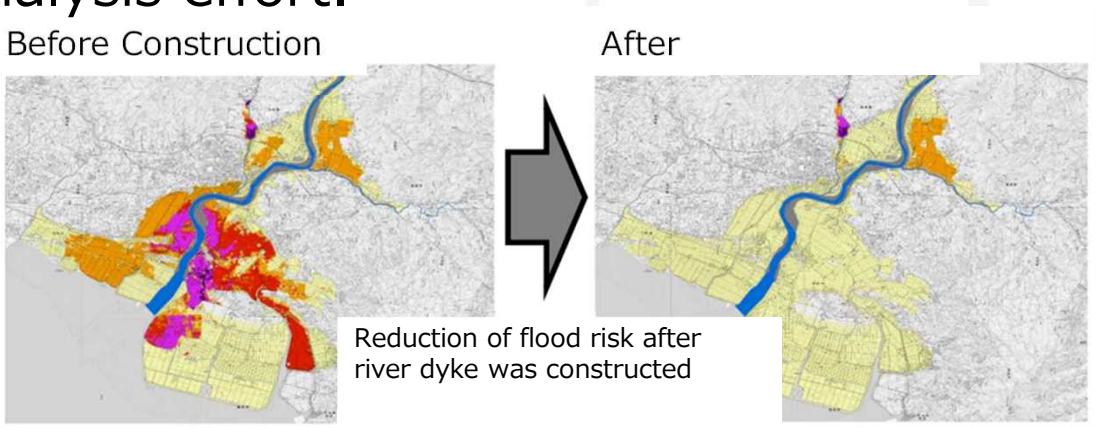
Purposes of flood risk map

- Show where and how much damage will occur
- Help the manager decide where to implement flood mitigation measures (levees, dams, etc.) and develop a land use plan based on expected damages
- Inform citizens where to live and where to evacuate



The need of Flood Risk Mapping Project

- Some global risk maps are available, such as AQUEDUCT. These maps are based on coarse topographical and rainfall data and are not very reliable. In addition, they do not reflect the reduction in risk from river improvement.
- Therefore, it is important to create a map that accurately reflects the conditions of the area and project effects.
- On the other hand, flood risk mapping requires accurate topographic data of a river basin and the river, rain conditions, etc., and an analytical model of rainfall-runoff-inundation is necessary, which requires a lot of observation and analysis effort.



Procedures of Flood Risk Mapping

Data Collection

- ✓ Collect and organize necessary data for model development, including rainfall (ground-based), water level and discharge, elevation, land use, flood control facility.

Selection of data to be used / Calculation of probable rainfall

- ✓ After evaluating the quality of collected data, including accuracy and missing data rates, the selection of data to be used for analysis and validation is determined.
- ✓ Additionally, probable rainfall intensity levels are set. (1/2year,1/5years,1/10years…)

Development of Model and Validation

- ✓ Develop runoff analysis and inundation analysis model
- ✓ Parameter tuning and validation using flood record

Creation of the Flood Risk Map

- ✓ Calculate inundation area with some probable floods
- ✓ Create a prototype flood risk map

Drafting the Guideline

- ✓ Summarize a procedure, necessary data, key point for flood risk assessment and flood risk mapping, and its utilization.

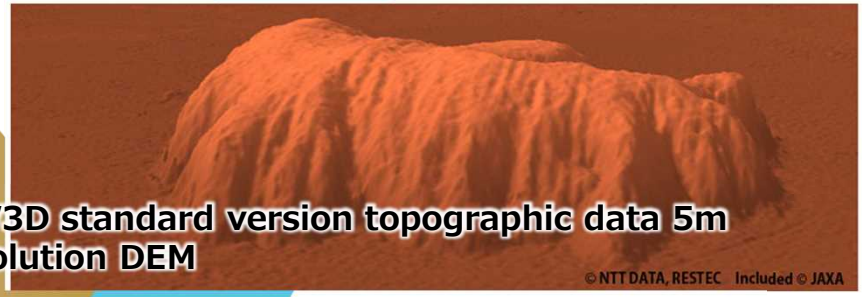
Difficulties related to flood risk mapping and solutions using Japanese technology

Difficulty	Explanation	Proposed solutions
A. Understanding river basin and river channel topography	Measuring watershed topography and cross-sectional river geometry is time-consuming and labor-intensive.	JAXA satellite observation data • High-accuracy 30m elevation data (free of charge) • 5m elevation data (at low cost)
B. Understanding river connections	It is difficult to reproduce actual river runoff because river connections and water flow cannot be accurately established based on elevation data alone.	Tokyo Univ.'s "MeritHydro" • Greatly reduce efforts to establish river connections
C. Understanding rainfall in the watershed	Long-term observations with densely installed rain gauges are necessary to determine the probable rainfall in the region.	JAXA's GSMaP • Able to obtain estimates of actual hourly rainfall data over the past 25 years • Can be used to calculate probable rainfall
D. Rainfall-Runoff-Inundation modeling	In general, rainfall, runoff and flooding are analyzed using separate models. Combining the three models requires a great deal of effort.	Kyoto Univ. & ICHARM's RRI model • The three phenomena can be analyzed together, making it easier to build a model.

A. Understanding river basin and river channel topography

Satellite survey topographic data from JAXA and other agencies is available free of charge for 30m elevation and inexpensively for AW3D 2.5m/5m . The cross-sectional shape of the river channel can also be estimated using this data.

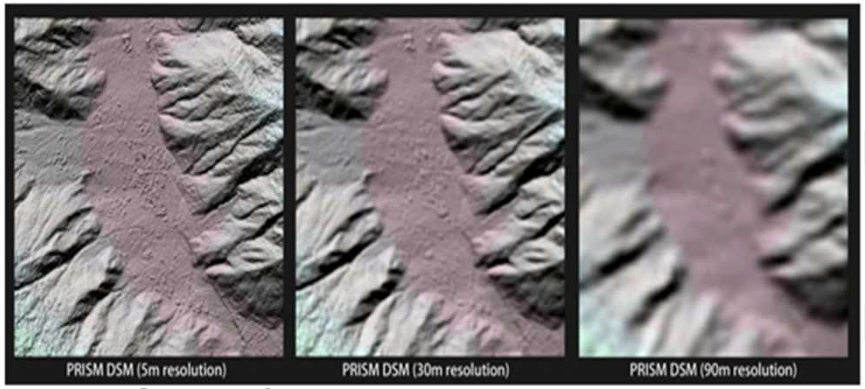
AW3D 30m/5m/2.5m



Comparison with previous global topographic data (Ayers Rock)

https://www.restec.or.jp/solution/aw3d/standard.html

- ✓ High-precision digital 3D map with a resolution of 2.5m/5m covering the entire land area, using images taken by the Advanced Land Observing Satellite "Daichi" (ALOS) . JAXA began developing it in
- ✓ 30m version is provided free of charge by JAXA .
- ✓ The standard version of 5m/2.5m is sold by NDD-Data/RESTEC (relatively inexpensive)



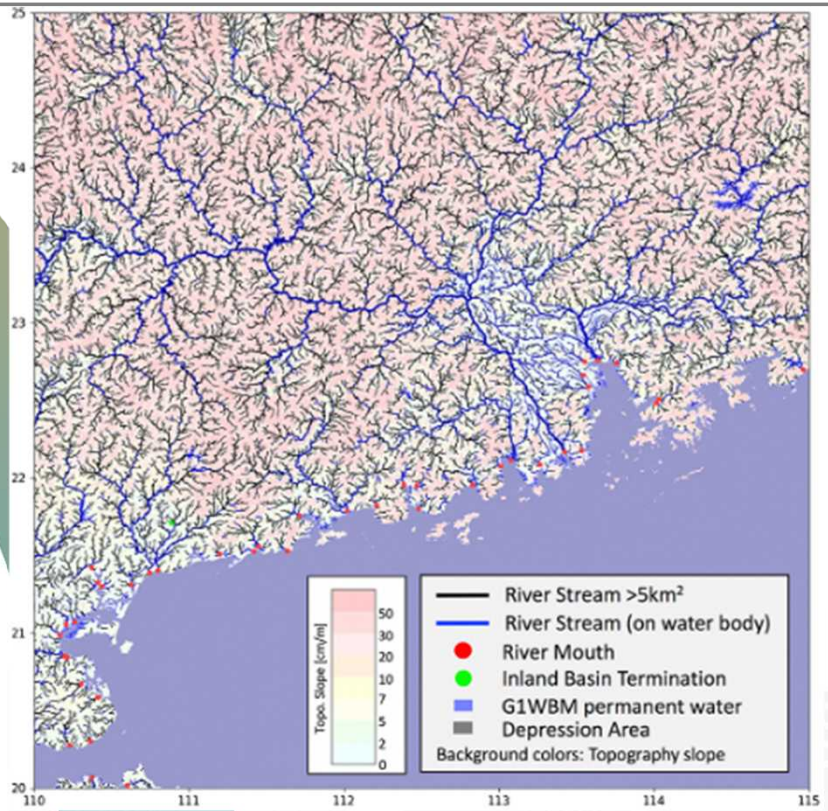
Comparison of DEM
Left: 5m resolution, Center: 30m, Right: 90m

https://www.eorc.jaxa.jp/ALOS/aw3d/index.htm

★30m https://www.eorc.jaxa.jp/ALOS/en/index.html ★5m/2.5m https://www.aw3d.jp/en/

B. Understanding of river connections

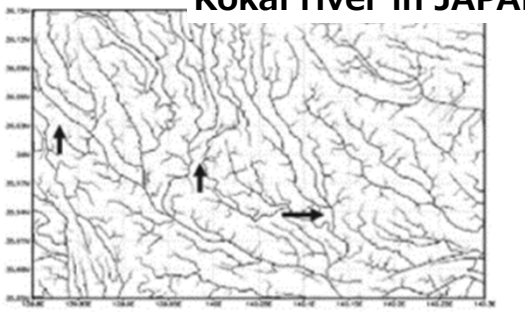
"MERIT Hydro" by Associate Prof. Yamazaki (University of Tokyo) et al. is high-precision (approximately 90m) global hydrogeomorphic data created from high-precision DEM , and represents appropriate river channel connections.



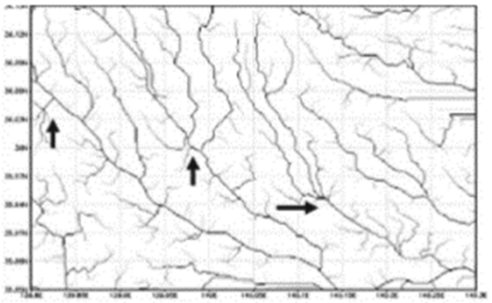
MERIT Hydro river network information (Near Pearl river in China)

http://hydro.iis.u-tokyo.ac.jp/~yamadai/MERIT_Hydro/

River network near the confluence of Tone, Kinu and Kokai river in JAPAN

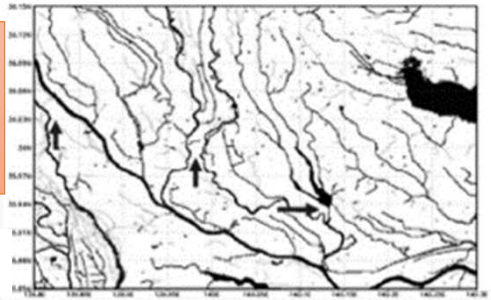


MERIT Hydro River Network



HydroSHEDS River Network

Compared to existing data from HydroSHEDS , MERIT Hydro properly represents small rivers such as the Tone River, Kinu River, and Kokai River.



Geospatial Information Authority of Japan Digital Land Information Water Area Data

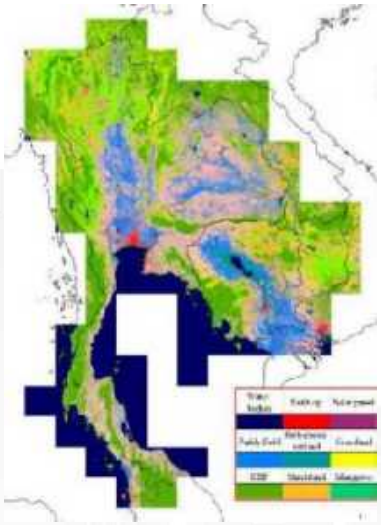
https://orsj.org/wp-content/corsj/or66-12/or66_12_828.pdf

MERIT DEM : DEM data created by separating and removing the main error components of previous satellite DEMs using SRTM3 DEM (v2.1) , AW3D-30m DEM (v1.0) , and Viewfinder Panoramas' DEM as the base data (Yamazaki Dai (University of Tokyo) et al .)

C. Understanding rainfall in the watershed

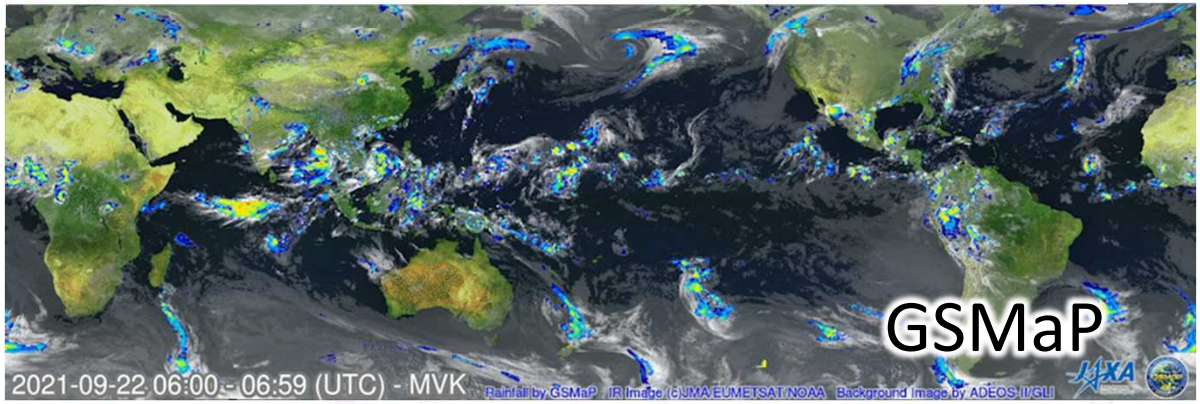
Japanese agencies* provide various types of satellite data and create climate change projection data to fill gaps of ground observation data.
The middle image shows global rainfall at 10 km resolution since 1998 (hourly rainfall).

* Ministry of Education, Culture, Sports, Science and Technology (MEXT) and Japan Aerospace Exploration Agency (JAXA)

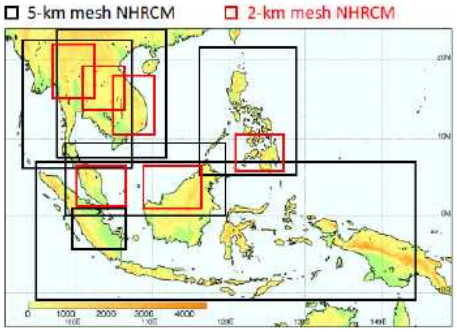


Land use classification by satellite observation

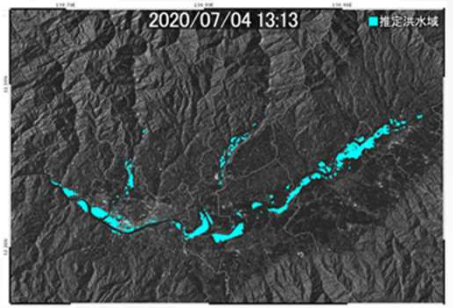
https://gportal.jaxa.jp/gpr/?lang=en



Global Satellite Mapping of Precipitation
*real-time precipitation data provided by JAXA



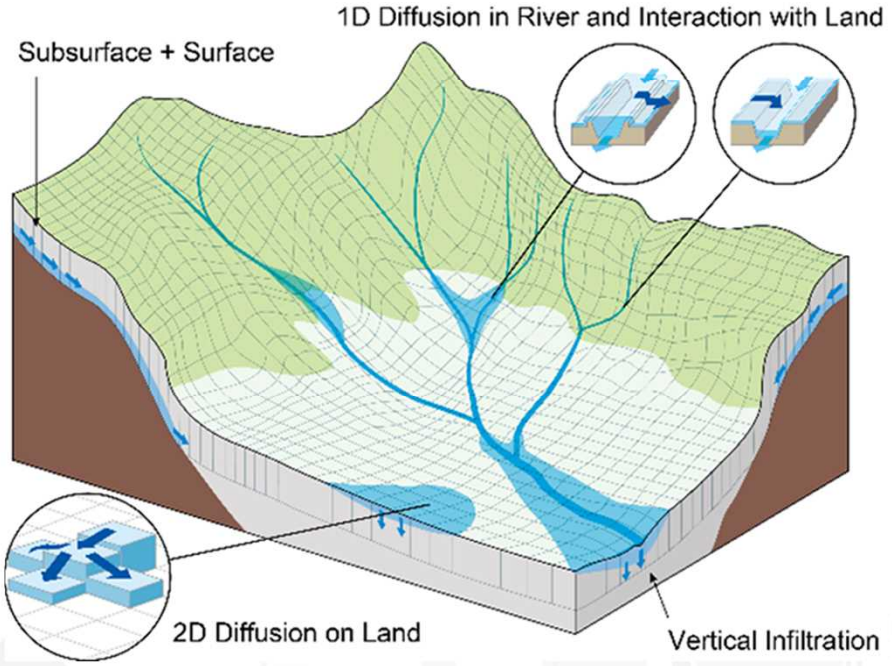
Creating Climate Change Projection data



Flooded area map by satellite observation

D. Rainfall-Runoff-Inundation Modeling

- RRI model, developed by Professor Sayama of Kyoto University and improved by ICHARM*, takes rainfall and other data as input and analyzes everything from river flow to flood inundation in a single system.



* ICHARM: International Center for Water Hazard and Risk Management under the auspices of UNESCO

Analysis using RRI model

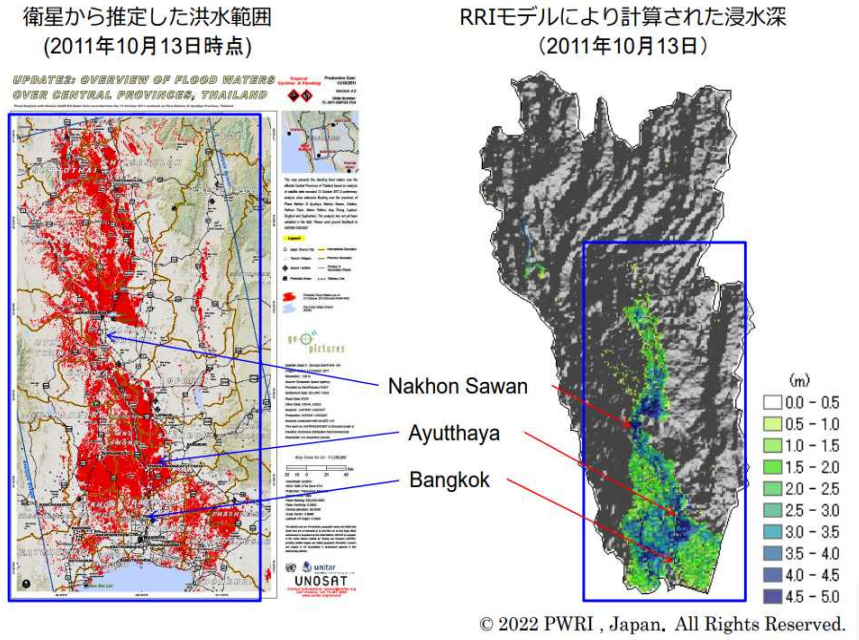
- The model deals slopes and river channels separately.
- The flow on the slope grid cells is calculated with the 2D diffusive wave model (subsurface flow considered)
- The channel flow is calculated with the 1D diffusive wave model.
- Interaction between slope and channel grid cells: Cassified into four cases according to river water level, slope water level and levee height and calculate using the step-down formula and overflow formula.

https://www.pwri.go.jp/icharm/research/rri/index.html

D. Rainfall-Runoff-Inundation Modeling

【 Features 】
- ✓ Extensive experience in Asian countries by ICHARM and others
- ✓ Can be handled everything from rainfall to flooding all at once
- ✓ User-friendly GUI for non-experts
- ✓ Available for free of charge
- ✓ Open-source, highly transparent
- ✓ Use physically-based model, highly explanatory

Country name	Basin name : CA(km2)	year	project
Thailand	Chao Phraya River : 160,000km2	～2013	JICA (Japan)
Pakistan	Indus River : 400,000 km2	～2013	UNESCO
Philippines	Pampanga River : 10,000 km2	～2013	ADB
Indonesia	Solo River : 16,000 km2	～2015	MEXT(Japan)
Cambodia	Lower Mekong :	～2015	MEXT(Japan)
Malaysia	Kelantan River : 12,000 km2	～2015	MEXT(Japan)
Indonesia	Kapuas River : 90,000 km2	2024～	MLIT(Japan)
Cambodia	Sankar River : 5000km2	2024～	MLIT(Japan)



Case study (Chao Phraya River Basin, Thailand)

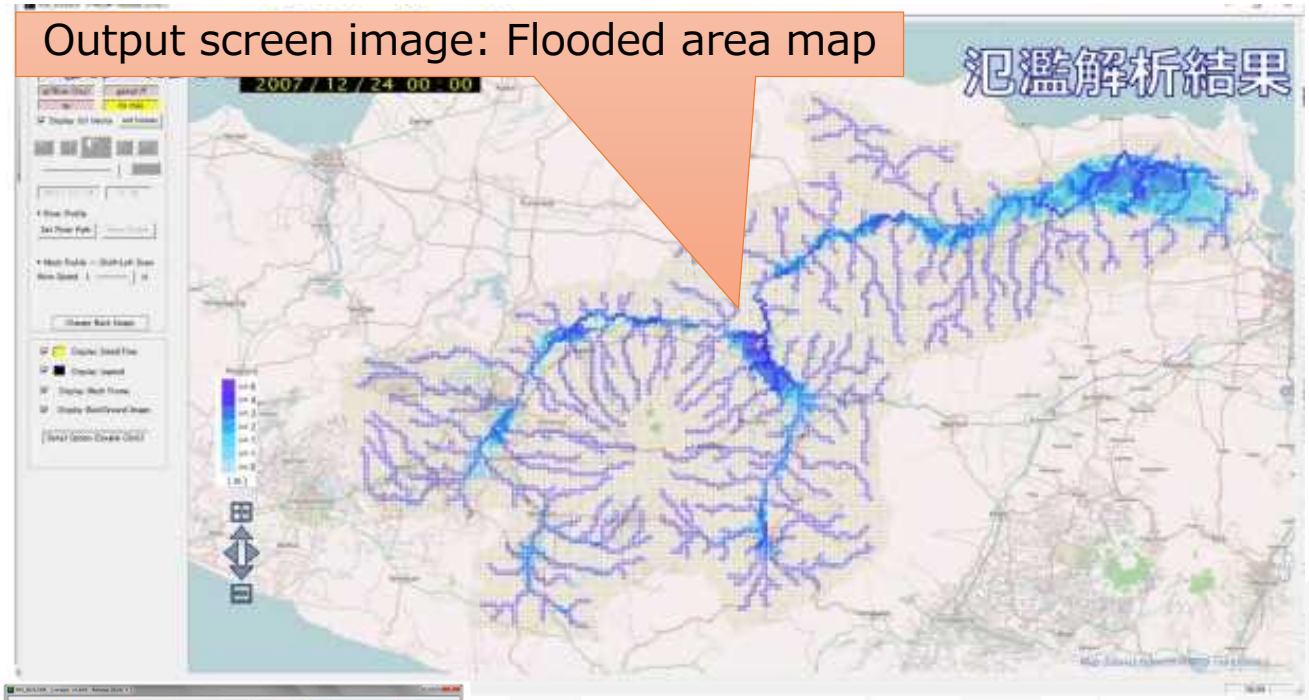
Application and implementation of RRI model

https://www.pwri.go.jp/jpn/results/tec-info/siryou/showcase/2020/takamatsu/pdf/SC2020_takamatsu06.pdf

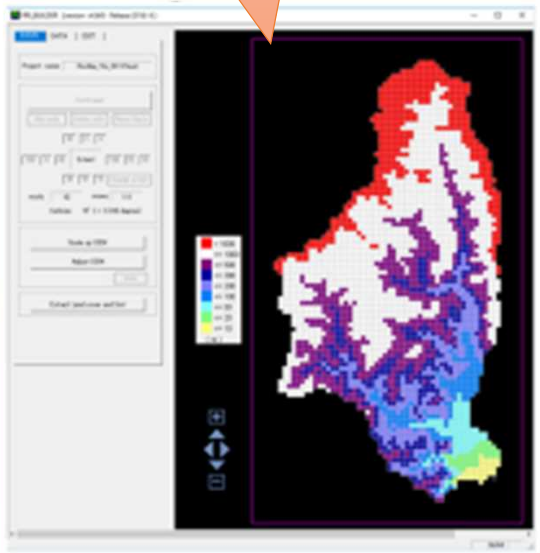
D. Rainfall-Runoff-Inundation Modeling

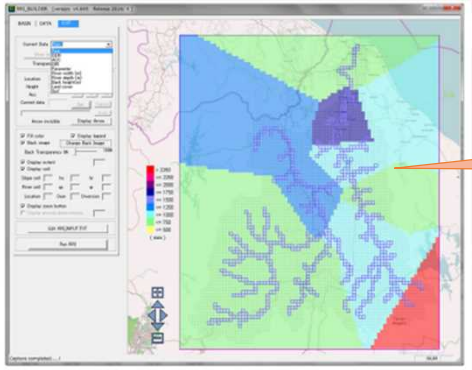
RRI model GUI

Output screen image: Flooded area map



Input screen image: Mesh size adjustment





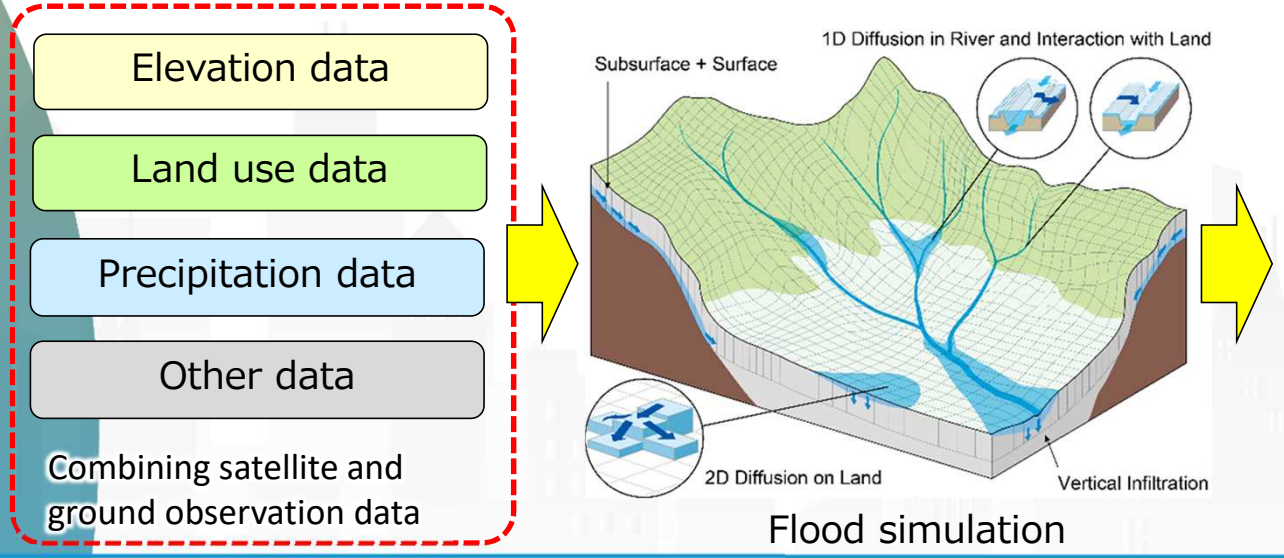
Input screen image: Reflection of rainfall data

https://www.pwri.go.jp/jpn/about/pr/event/2022/0614/pdf/1555.pdf

Progress of Flood Risk Mapping Project in Asia

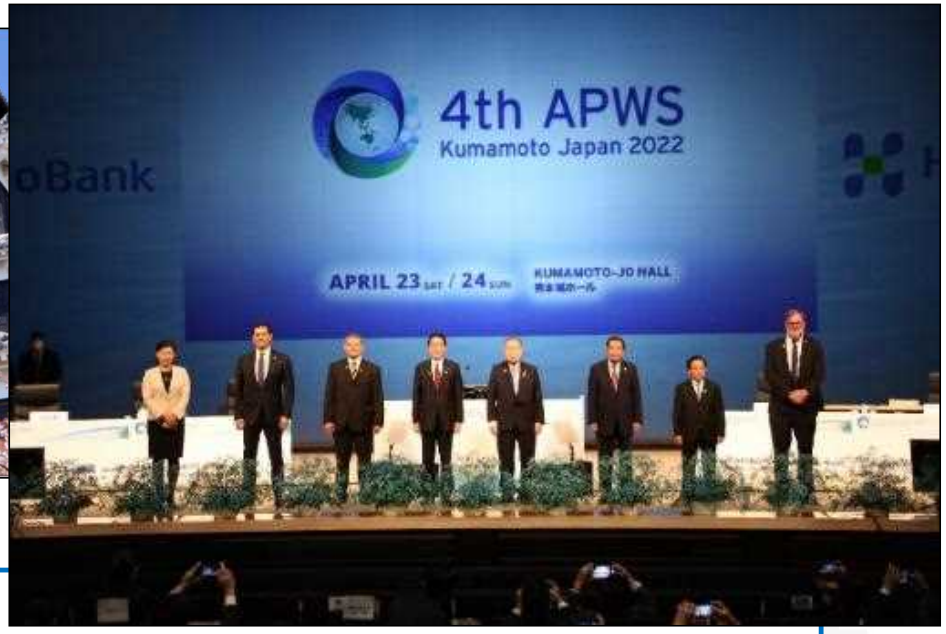
- Flood Risk Mapping in some Asian countries

Necessary actions cannot progress without accurately locating water-related disaster risks in an easy-to-understand manner for decision-makers and local communities.
Therefore, MLIT have been working to produce Flood Risk Maps that show the potential inundations in target areas in some Asian countries*.
Combining satellite data with ground observation data, applying climate change projection if possible, and providing it to computer flood simulations.
Also, MLIT will put together guidelines for producing the Flood risk Maps. And with the collaboration with MEXT for DIAS-based training programs, MLIT will contribute to capacity development support for data utilization and Flood risk Mapping.



*Indonesia, Cambodia, Thailand and Vietnam

4th Asia-Pacific Water Summit (2022)

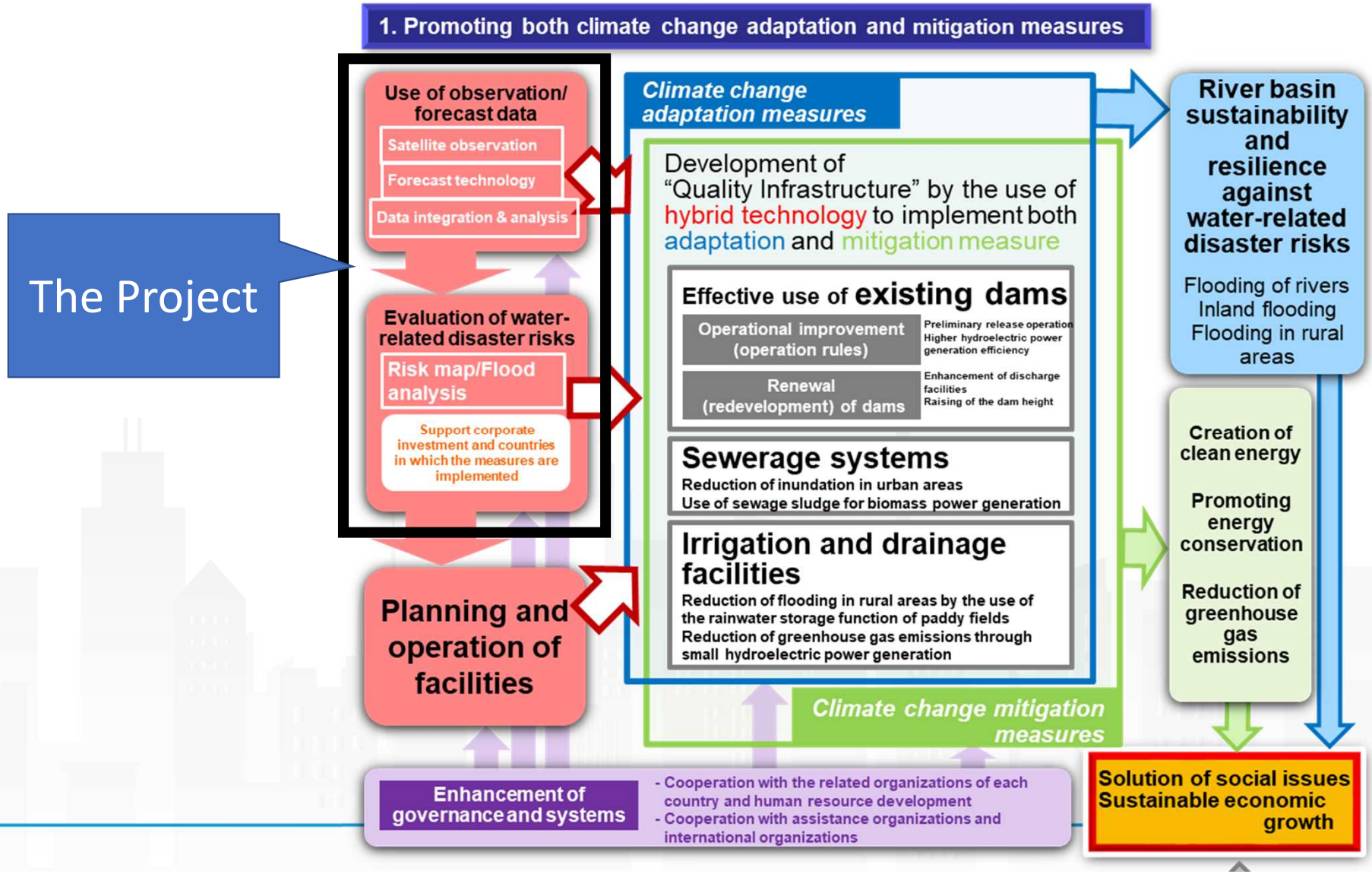


Result of the Water Summit

◆Approximately 5,500 participants including online with the Heads and Ministers of State and Government from 30 countries in the Asia-Pacific region discussed various water-related issues in this Water Summit.

◆His Majesty the Emperor of Japan gave his Remarks and Commemorative Speech at the Opening Ceremony, after that Mr. Kishida, Prime Minister of Japan, announced "Kumamoto Initiative for Water", and "Kumamoto declaration" expressed the determination by the Heads of State and Government was adapted at the Heads of State and Government Meeting.

Kumamoto Initiative for Water (part of Outline)



Thank you for your kind attention!

CWW2024
Water and Climate
Building Resilient Communities
13th – 17th Oct 2024
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CAIRO WATER WEEK

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