Japan's Contribution to the Consideration of Climate Change Adaptation Measures in the Republic of the Philippines

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/Institute of Industrial Science

What is a flood hazard map?

- ✓ The mayors of cities, towns, and villages (including special wards) are responsible for creating the map.

  Based on Article 15, Paragraph 4 of the Flood Control Act, the mayors of cities, towns, and villages distribute the printed maps and take other necessary measures.

- ✓ The map shows the areas expected to be flooded.

  The map shows areas that are expected to be flooded if rivers overflow. Pursuant to the Flood Control Act, the national or prefectural governments designate areas expected to be flooded and notify municipalities.

- ✓ The map also includes evacuation information.

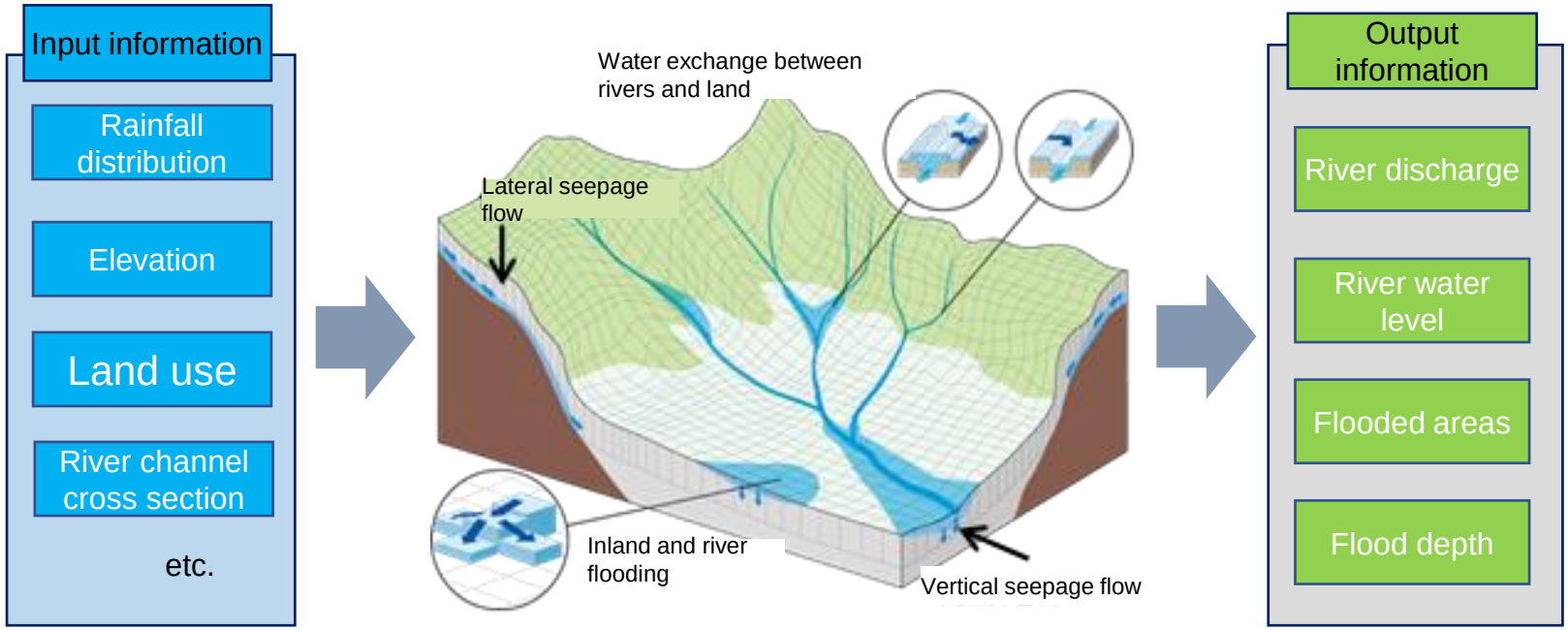
  The map also includes information on how flood forecasts are communicated, evacuation sites, and other matters necessary to ensure smooth and rapid evacuation in the event of a flood.

- ✓ Almost all municipalities have published the map.

  Ninety-eight percent of the target municipalities (including special wards) have already published the map (as of the end of July 2021 according to the MLIT survey).

What does it mean to assume flooding?

Flood analysis concept (in the case of a river flood)



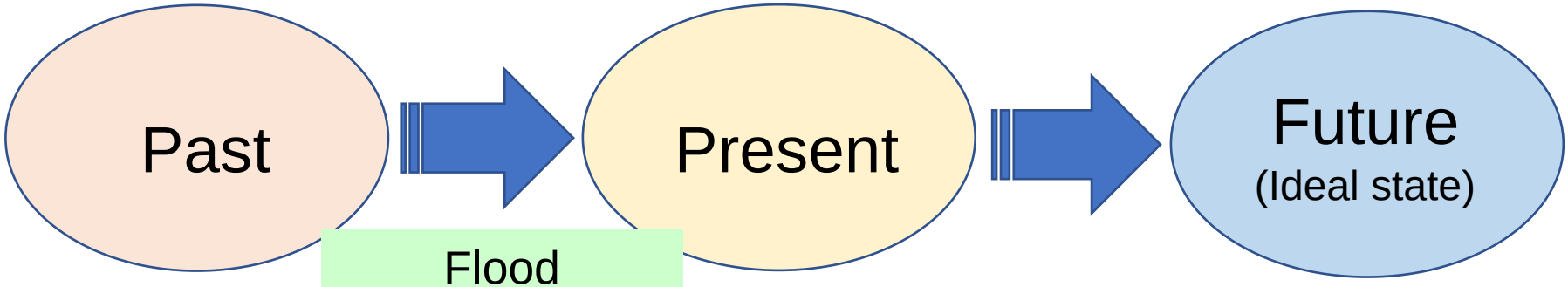
(Figure: Public Works Research Institute)

Past, present, and future: Thinking from the viewpoint of flood disaster

○ Depending on data and experience for:
- Disaster prediction
- Damage estimates
- Learning lessons

Building a risk-informed society

Considering climate/social changes in the future



Flood analysis/map

Accumulation of rainfall observation area data

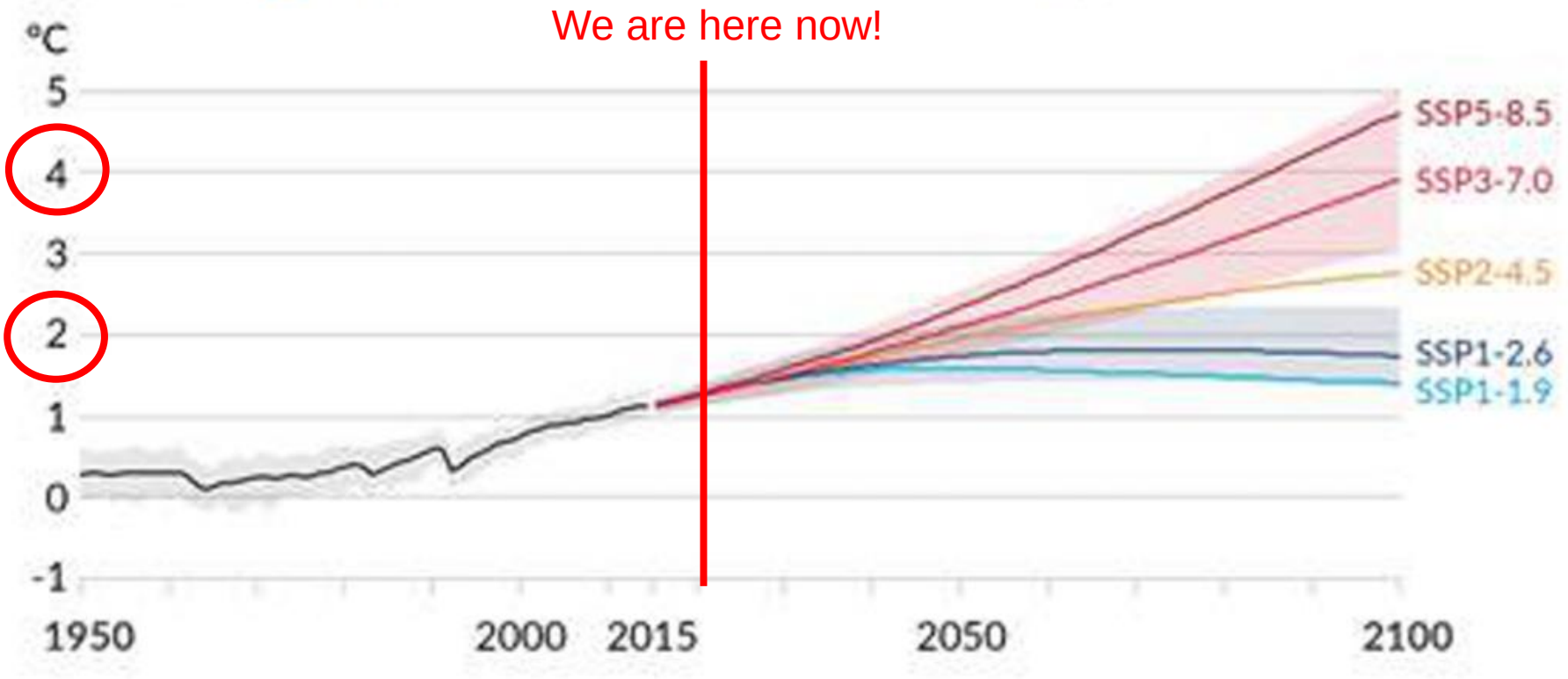
○ Anticipating the future situation

↓

Designing and realizing a society to avoid future regrets

Future climate change

a) Change in global average temperature relative to the period 1850–1900



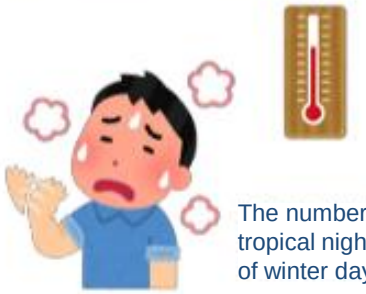
Ministry of the Environment: Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, Working Group I Report (Natural Sciences)

Summary of future projections

In Japan at the end of the 21st century compared to the 20th century...

* Yellow letters represent projections based on a 2-degree Celsius increase scenario (RCP2.6).
Purple letters represent projections based on a 4-degree Celsius increase scenario (RCP8.5).

The annual average temperature will increase by approx. 1.4℃/4.5℃.



The number of extremely hot days and tropical nights will increase, while the number of winter days will decrease.

Sea surface temperatures will rise by approx. 1.14℃/3.58℃.

Due to its proximity to land that warms easily and the influence of warm currents, the predicted increase is greater than the global average.

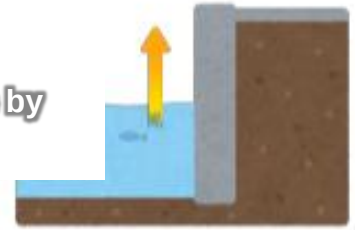
Snowfall and snow accumulation will decrease.

It rains instead of snows. However, the risk of heavy snow may not necessarily decrease.

Torrential rains will increase.

The annual maximum daily precipitation amount will increase by approx. 12% (approx. 15 mm)/approx. 27% (approx. 33 mm).
The frequency of rainfall of 50 mm/h or more will increase by about 1.6 times/2.3 times.

Coastal sea levels will rise by approx. 0.39 m/0.71 m



Sea ice area in the Sea of Okhotsk in March will decrease by approx. 28%/70%.

[Reference] Under the 4-degree Celsius increase scenario (RCP8.5), it is predicted that most of the Arctic sea ice will melt in summer in the mid-21st century.

The proportion of strong typhoons will increase.
The rain and winds associated with typhoons will intensify.

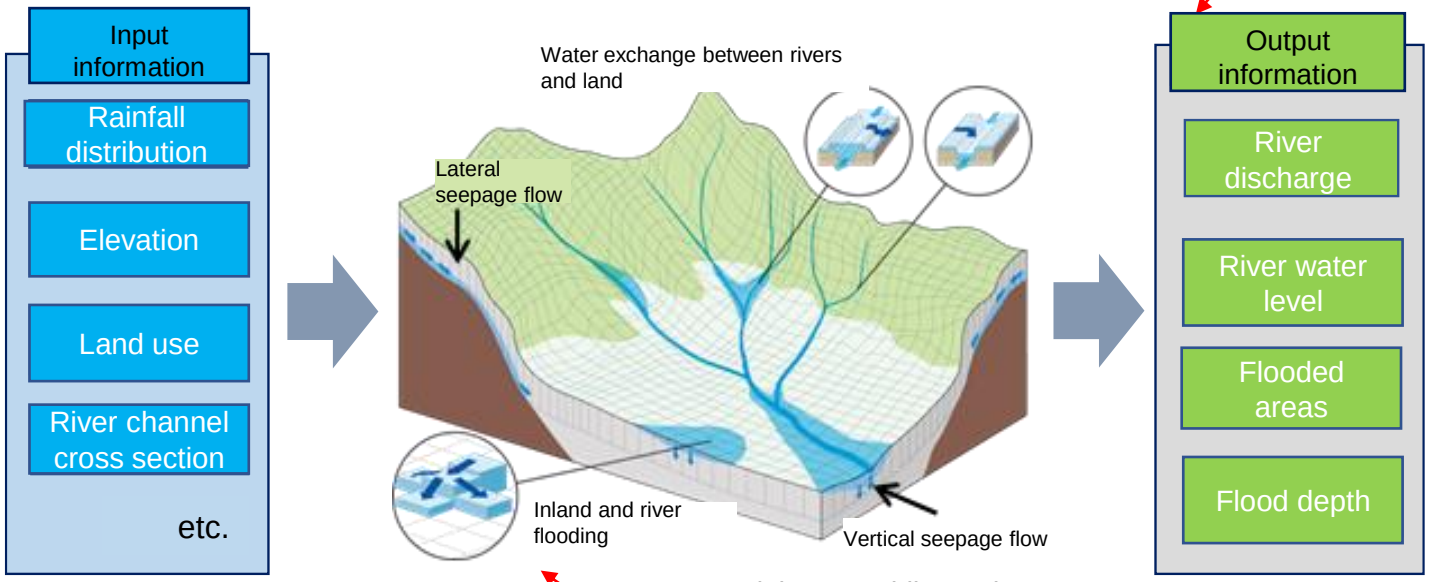
Ocean acidification will progress at a rate similar to the global average in areas south of Japan and around Okinawa.

*Unless otherwise specified, “future projections” in this document refer to projections for the whole of Japan as of the end of the 21st century compared with the end of the 20th century or the present.

Why is it difficult to predict and map flooding in developing countries?

Technical challenges

- No input data/poor accuracy
- There is no accumulated rainfall observation data
- The analysis cannot be verified due to lack of observational data.



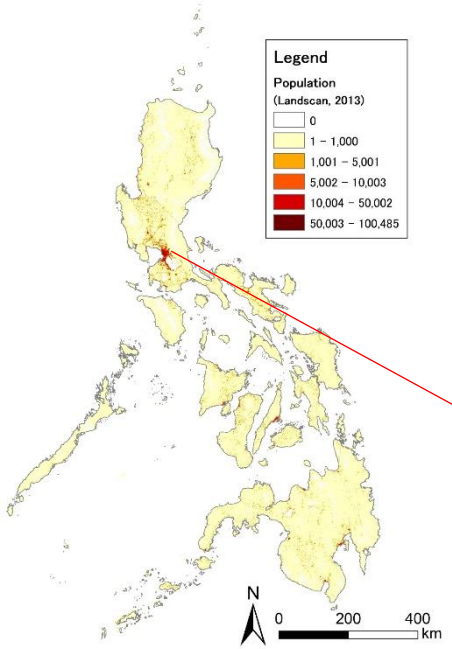
(Figure: Public Works Research Institute)

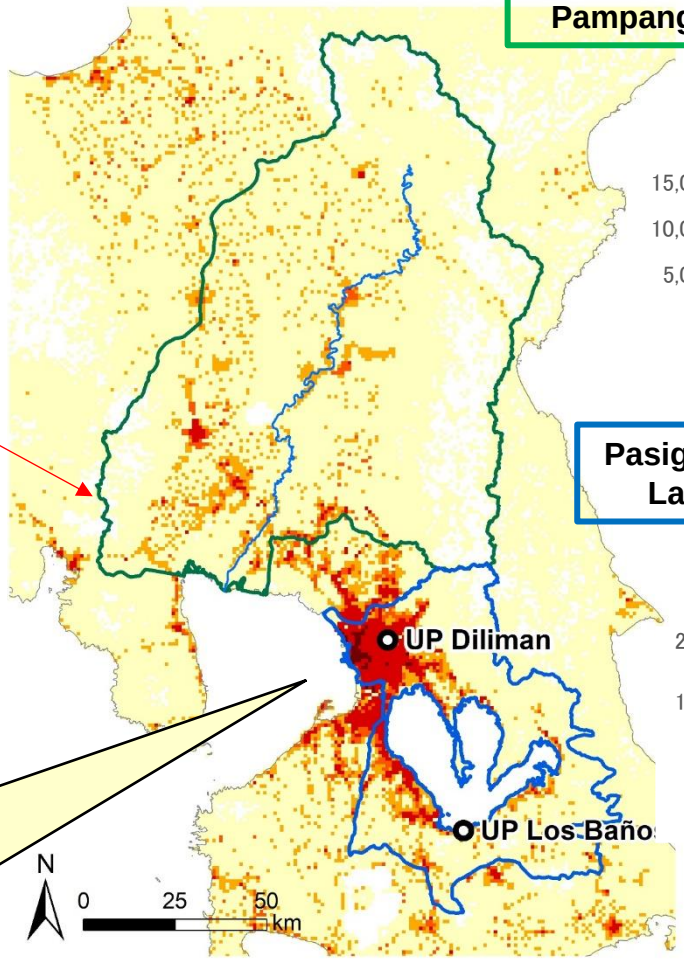
Institutional challenges

- Undeveloped legal system
- Difficult to achieve unity at the local government level

- Few people who can understand
- Lack of computer environment
- No other data available on facilities, etc.

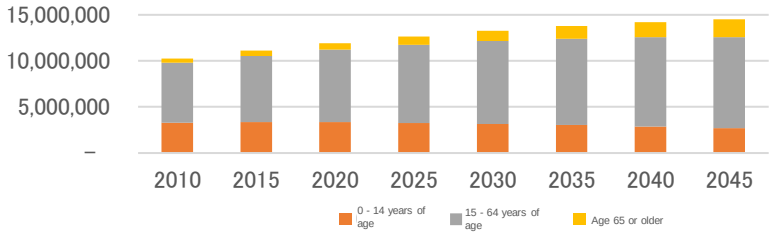
Concerns about increased flood risk due to population growth





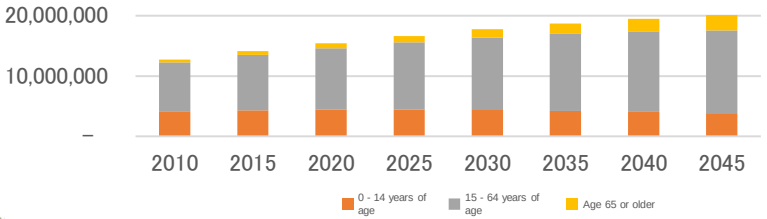
Pampanga River Basin

By 2045
population will increase by
1.2 times.



Pasig-Marikina River and Laguna Lake Basin

By 2045
population will increase by
1.3 times.



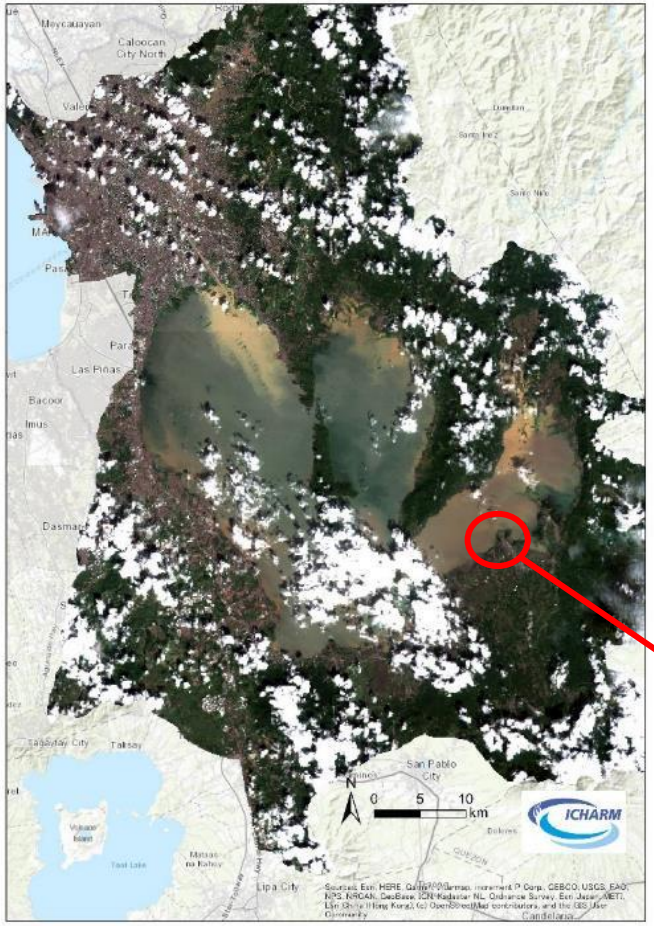
Population: Based on Philippine Statistics Authority estimates

2009.9-10
Typhoon Ondoy: 501 victims
Typhoon Pepeng: 539 victims
Typhoon Santi: 39 victims
Total: 1,079 victims

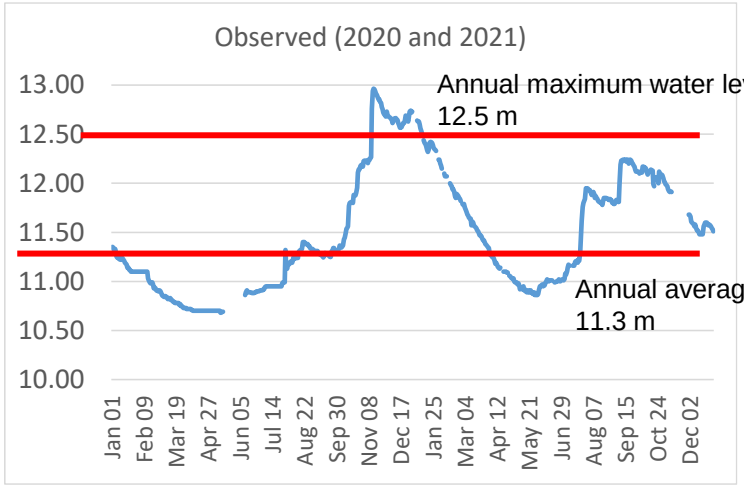
Present: There is no national flood hazard mapping system.
Future: The need to promote healthy regional development based on objective disaster risk assessments that take climate change into account

Pasig-Marikina River and Laguna Lake Basin

Nov. 2020 Typhoon Ulysses



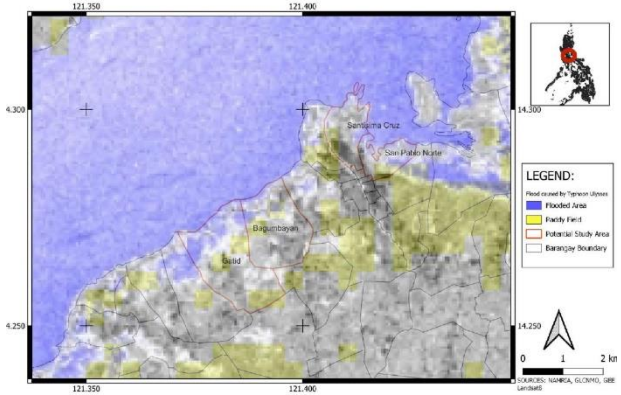
Changes in water levels of Laguna Lake during Typhoon Ulysses in Nov. 2020



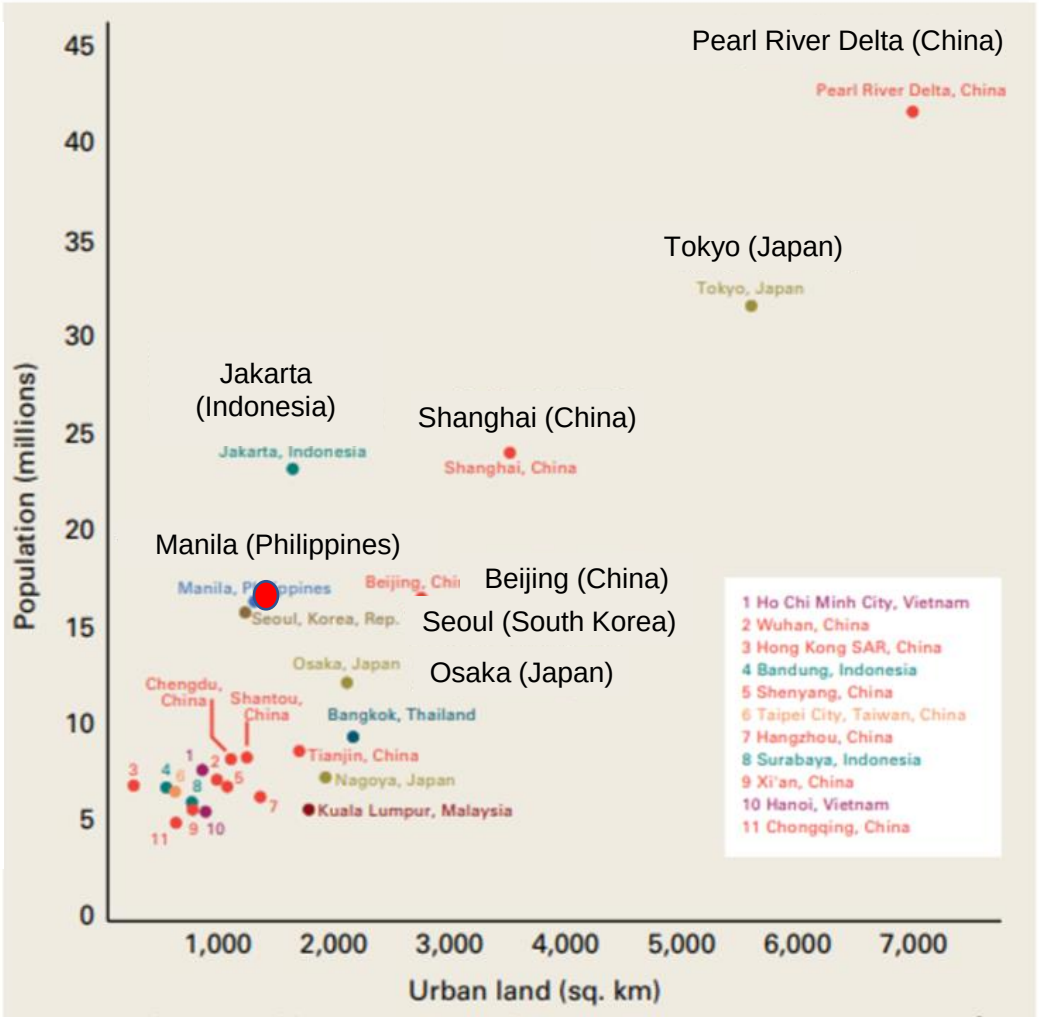
The Laguna Lake Development Authority has set the area at an altitude of 12.5 m or below as an area unsuitable for habitation.

Flooding shown in a satellite image

Flooded area based on satellite image analysis



The problem of accelerating overconcentration in the capital region



Area of urban area estimated from satellite images (unit: km^2)

Metro Manila, Republic of the Philippines

- The sixth largest city in East Asia
- In 2010, the city's population was 16.5 million, more than 10 times that of the country's second largest city, Cebu (population 1.5 million).
- The population forecast for 2050 (moderate-range projection) is 1.4 times the 2015 population of approximately 100.98 million.

- Further concentration in the capital region
- Deterioration of the urban environment

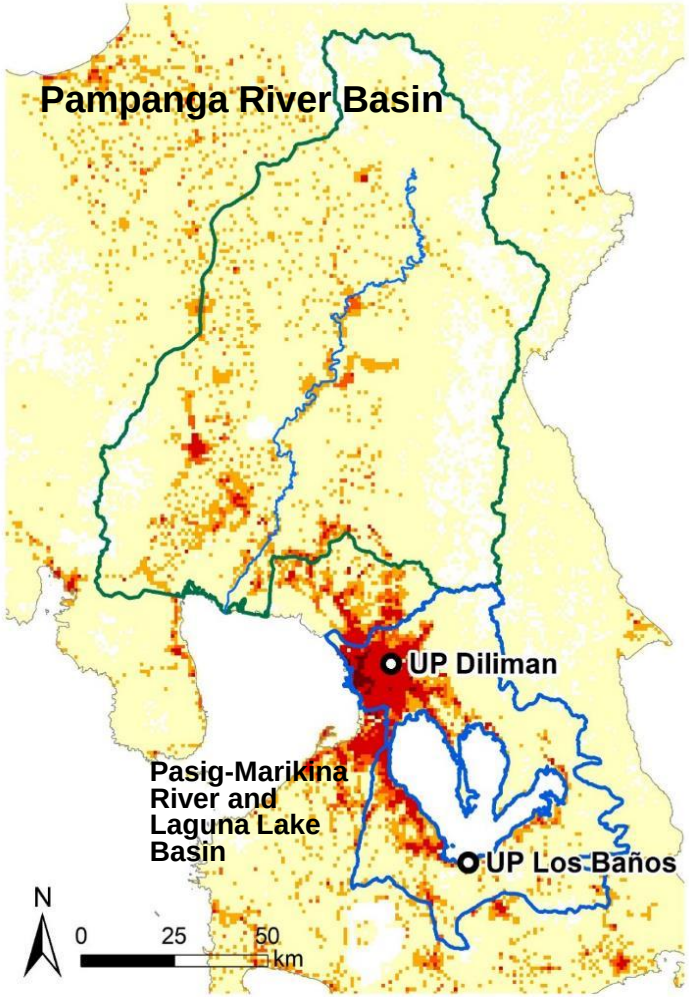
Source: World Bank report "East Asia Urban Transition"

10

SATREPS: Science and Technology Research Partnership for Sustainable Development

The Project for Development of Hybrid Water-Related Disaster Risk Assessment Technology for
Sustainable Local Economic Development Policy in the Philippines

Utilizing hybrid water disaster risk assessment for policy planning for sustainable regional economic development under climate change in the Republic of the Philippines

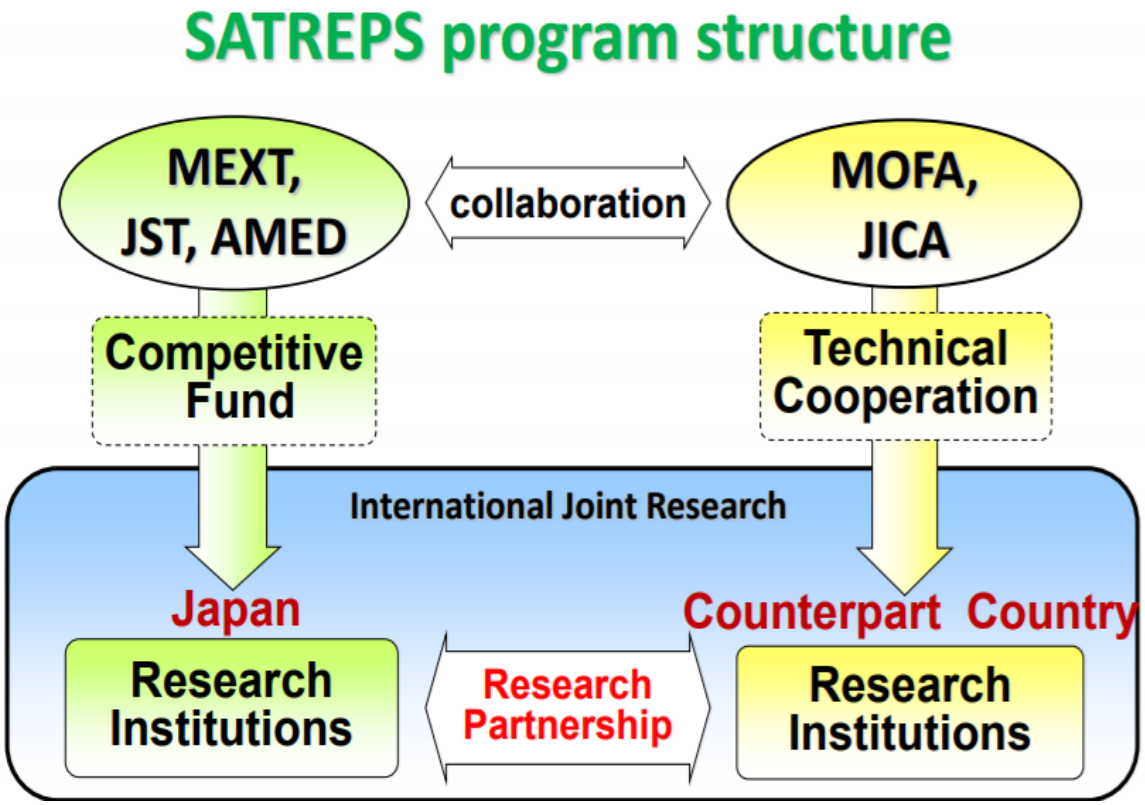


SATREPS
Science and Technology Research Partnership for Sustainable Development Program

HyDEPP

https://www.pwri.go.jp/icharm/research/articles/project-HyDEPP-SATREPS.html

SATREPS: Science and Technology Research Partnership for Sustainable Development



MEXT: Ministry of Education, Culture, Sports, S&T
JST: Japan Science and Technology Agency
AMED: Japan Agency for Medical research and Development
MOFA: Ministry of Foreign Affairs
JICA: Japan International Cooperation Agency

From the SATREPS website

HyDEPP-SATREPS Project

- Project goal

To provide policy recommendations for sustainable economic development in urban and rural areas under climate change based on a water disaster risk assessment using a hybrid model that combines climate change, hydraulics, hydrology, agriculture, and economic activities in the target watershed

- Overall goal

Policy recommendations for improving water disaster resilience and achieving sustainable economic development through balanced national development will be reflected in central and local government policies and plans.

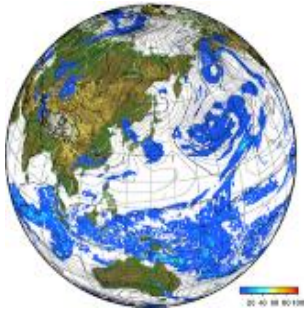
- Lead Research Institution
  Japan: University of Tokyo (Representative: Miho Ohara)
  Philippines: University of the Philippines Los Baños (UPLB)

- Participating research institutions
  Japan: University of Tokyo, Tohoku University, University of Shiga Prefecture, Nagoya University
  Philippines: University of the Philippines Diliman and Mindanao
  Partner agencies: Department of Science and Technology, Department of Public Works and Highways, Laguna Lake Development Authority, Metropolitan Manila Development Authority

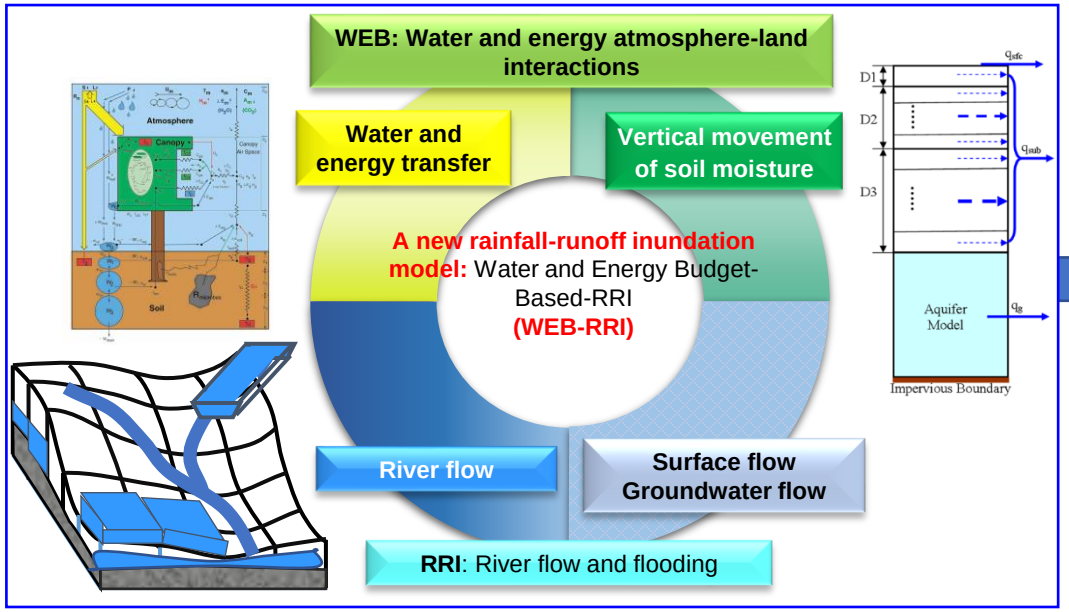
- Research implementation period:
  JICA project (in Philippines): June 3, 2021–June 2, 2026
  JST project (in Japan): April 1, 2020–March 1, 2025

What is a hybrid water disaster risk assessment model?

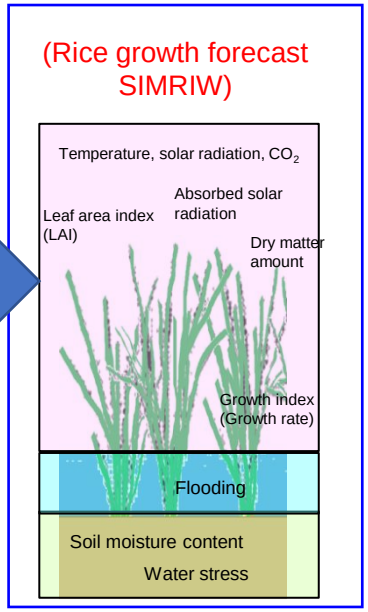
Climate change predictive model



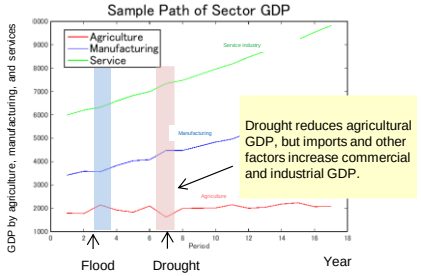
Hydraulic and hydrological model



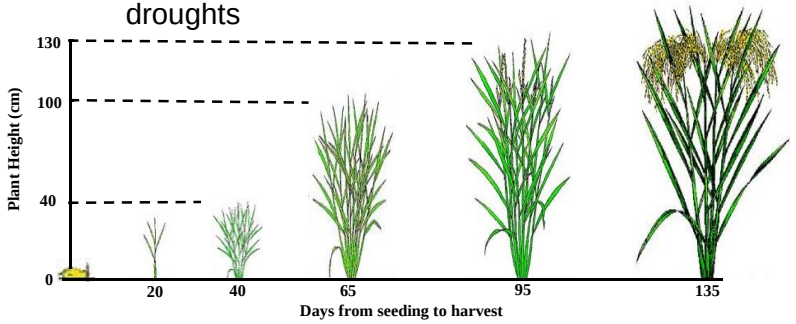
Agricultural model



Developing regional economic development scenarios with and without adaptation measures by using economic models



Predicting yield changes due to floods and droughts



Proposing policies for sustainable economic development under climate change

Project aims

- Contributing to policy decision-making through an end-to-end approach that consistently links observation and statistical data to visualization of the effects of disaster prevention investments
  ← The current situation where advance investment in disaster prevention is not progressing

- Trans-disciplinary approach
  ← Previously, Project NOAH was carried out in the Philippines mainly by researchers in the natural sciences.

- Establishing a sustainable review system in the Philippines
  The Philippine side can continue to conduct its own analysis and review.

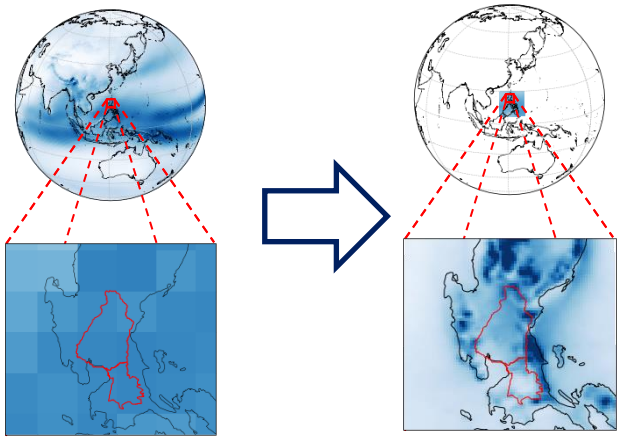
- Sharing and utilizing big data
  Continuing to use research results and data even after the project ends

Predicting future climate

Climate model group results

Global climate model (GCM)

Regional climate model (RCM)

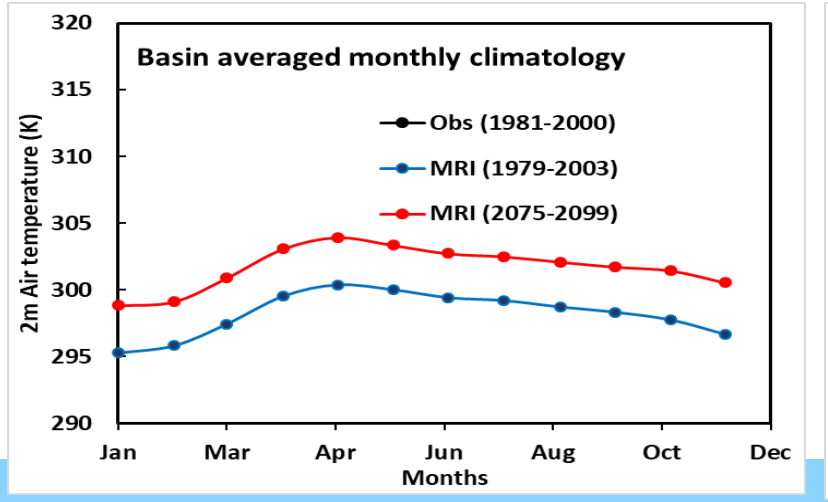


20 km grid

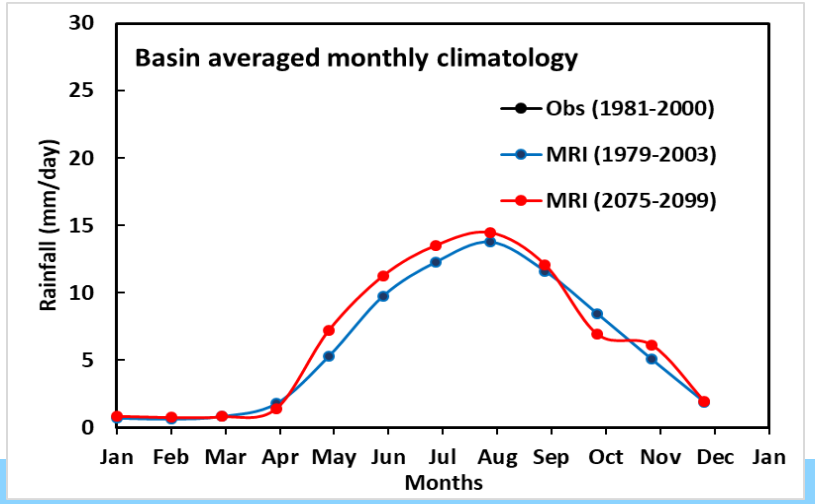
5 km grid

Used GCM	Present climate (1979–2003)	Future Climate 4-degree Celsius increase scenario RCP 8.5 (2075–2100)
MRI-AGCM 3.2S (Model of Meteorological Research Institute)	Downscaling for the Philippines and surrounding areas	Downscaling for the Philippines and surrounding areas

Future changes in air temperatures by month



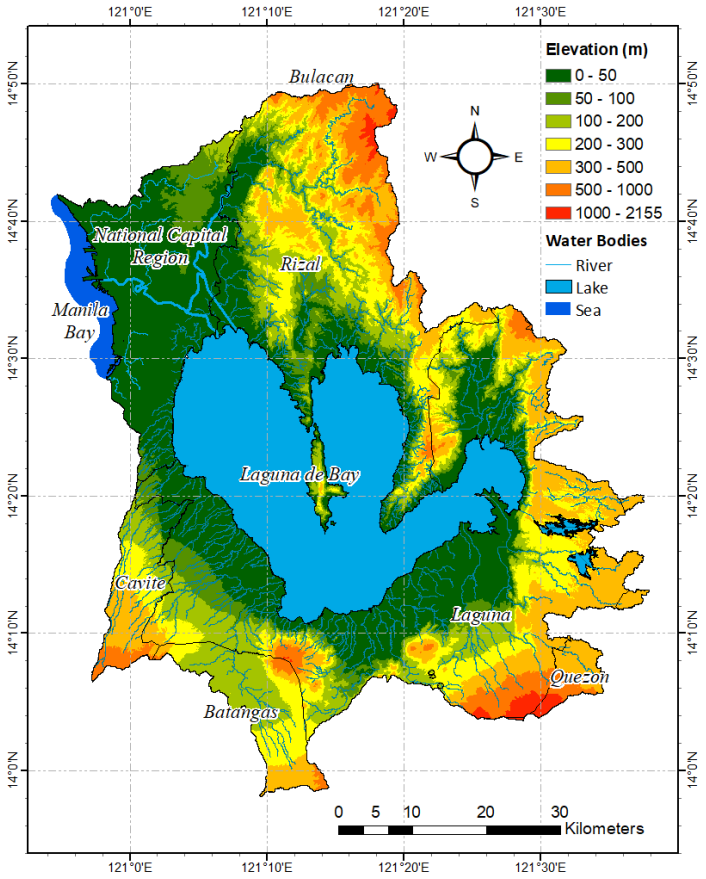
Future changes in daily precipitation by month

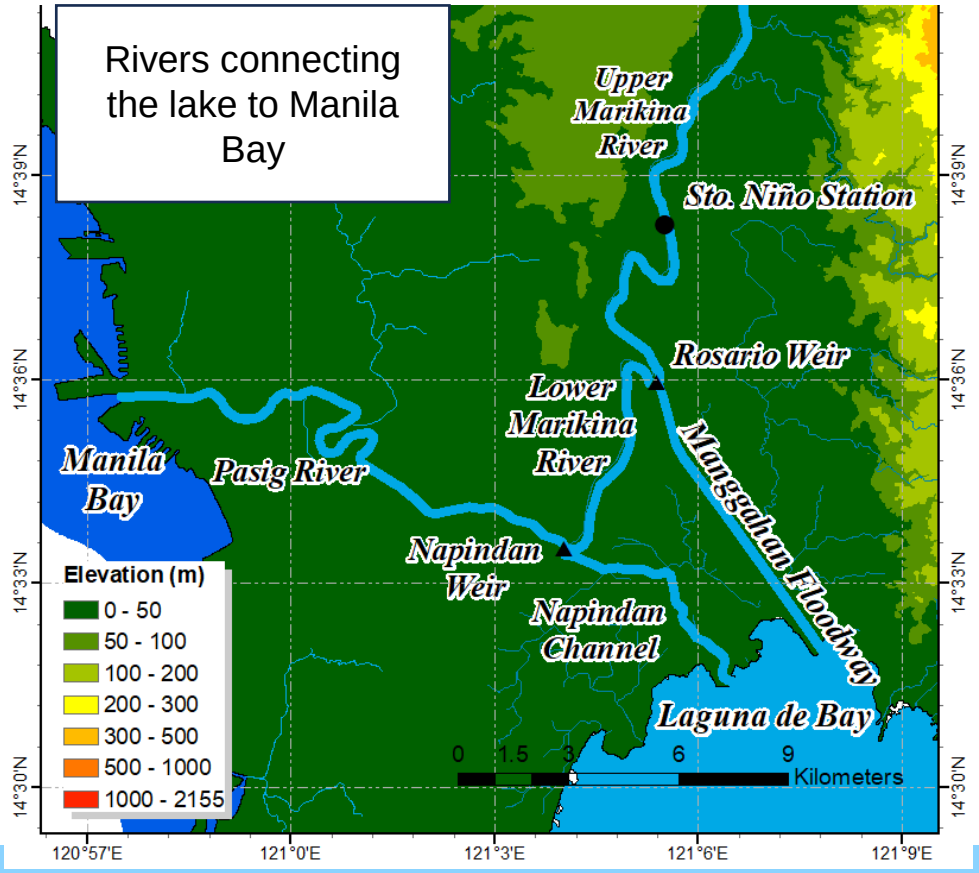


Pasig-Marikina River and Laguna Lake Basin

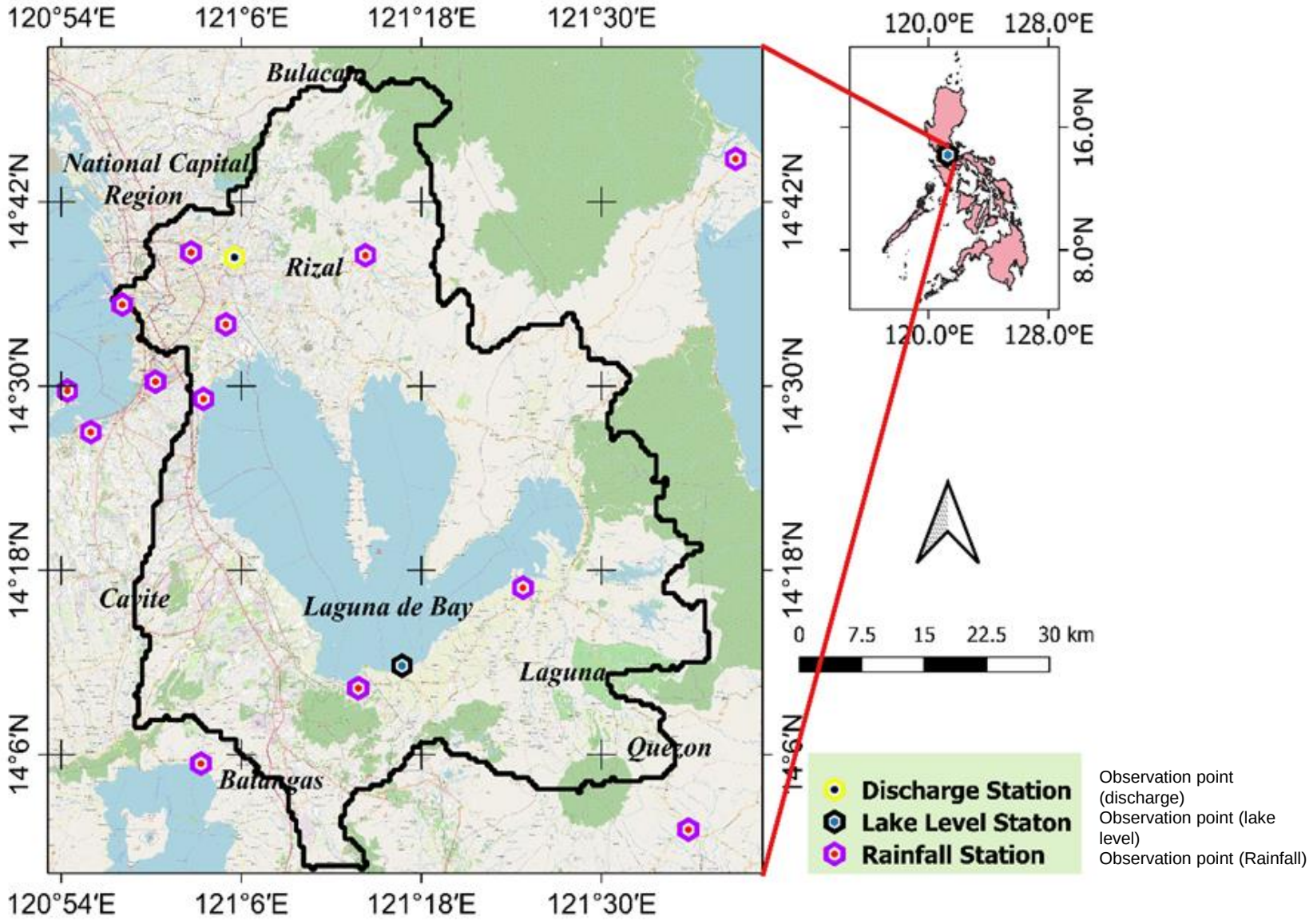
Flood analysis group

The results of doctoral thesis by Mr. Vicente Ballaran in Japan

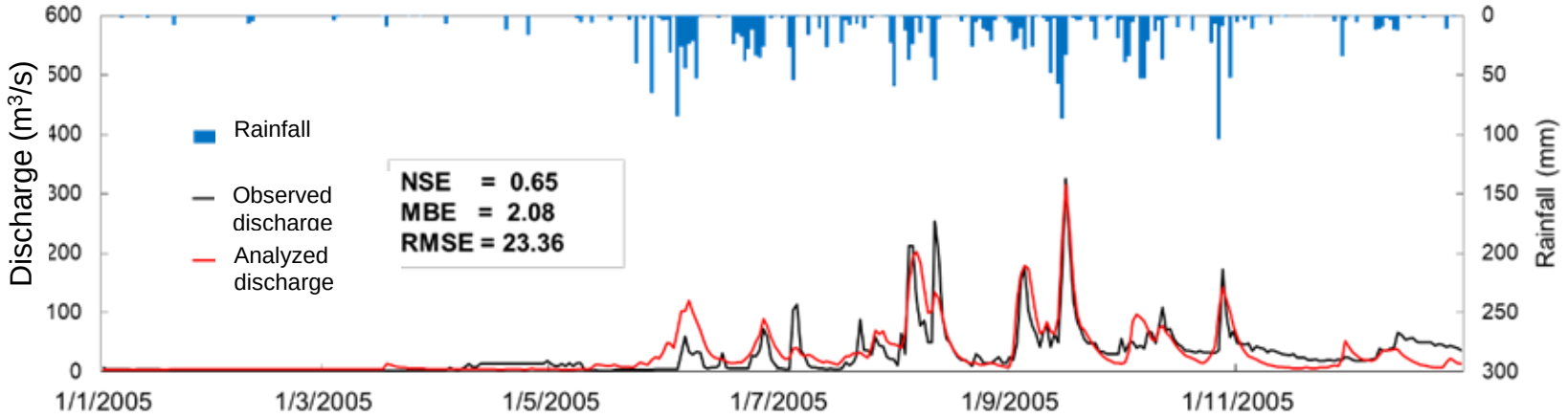


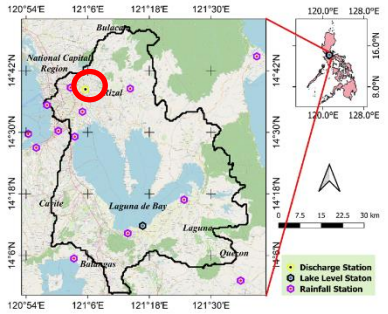


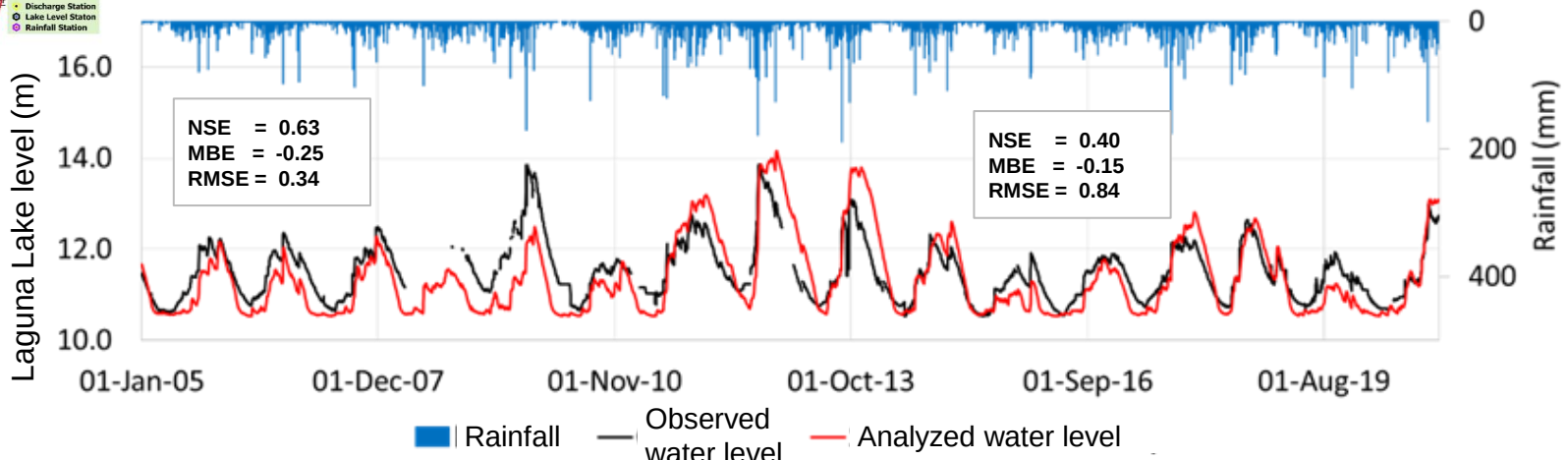
Pasig-Marikina River and Laguna Lake Basin



Analysis of change in discharge (top) and water level change in Laguna Lake (bottom)

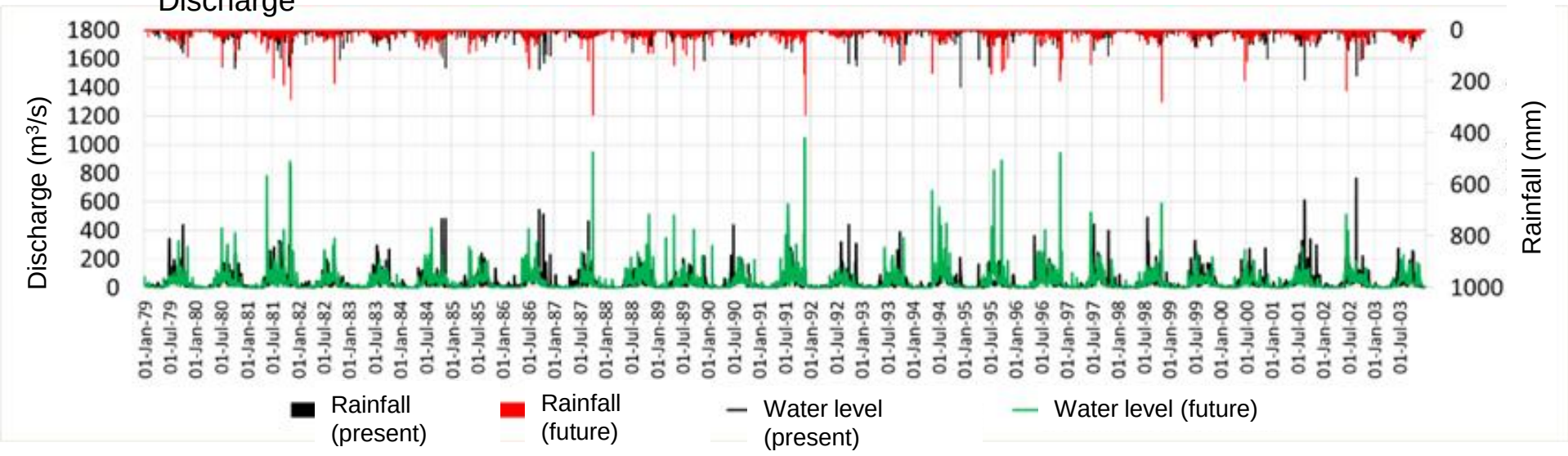






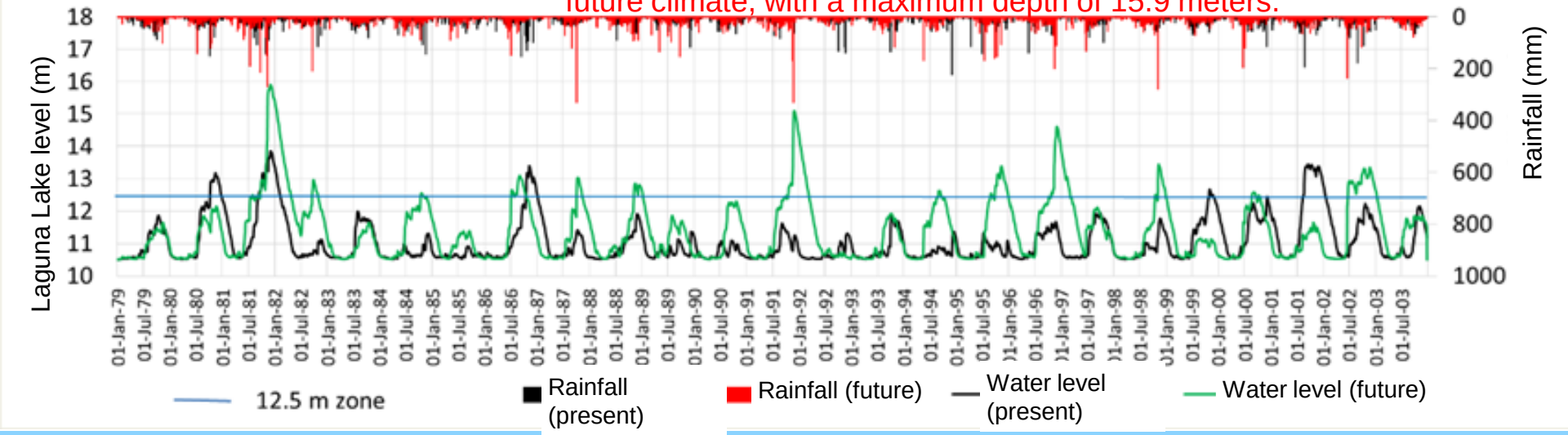
Changes over 25 years in the present and future climates

Discharge

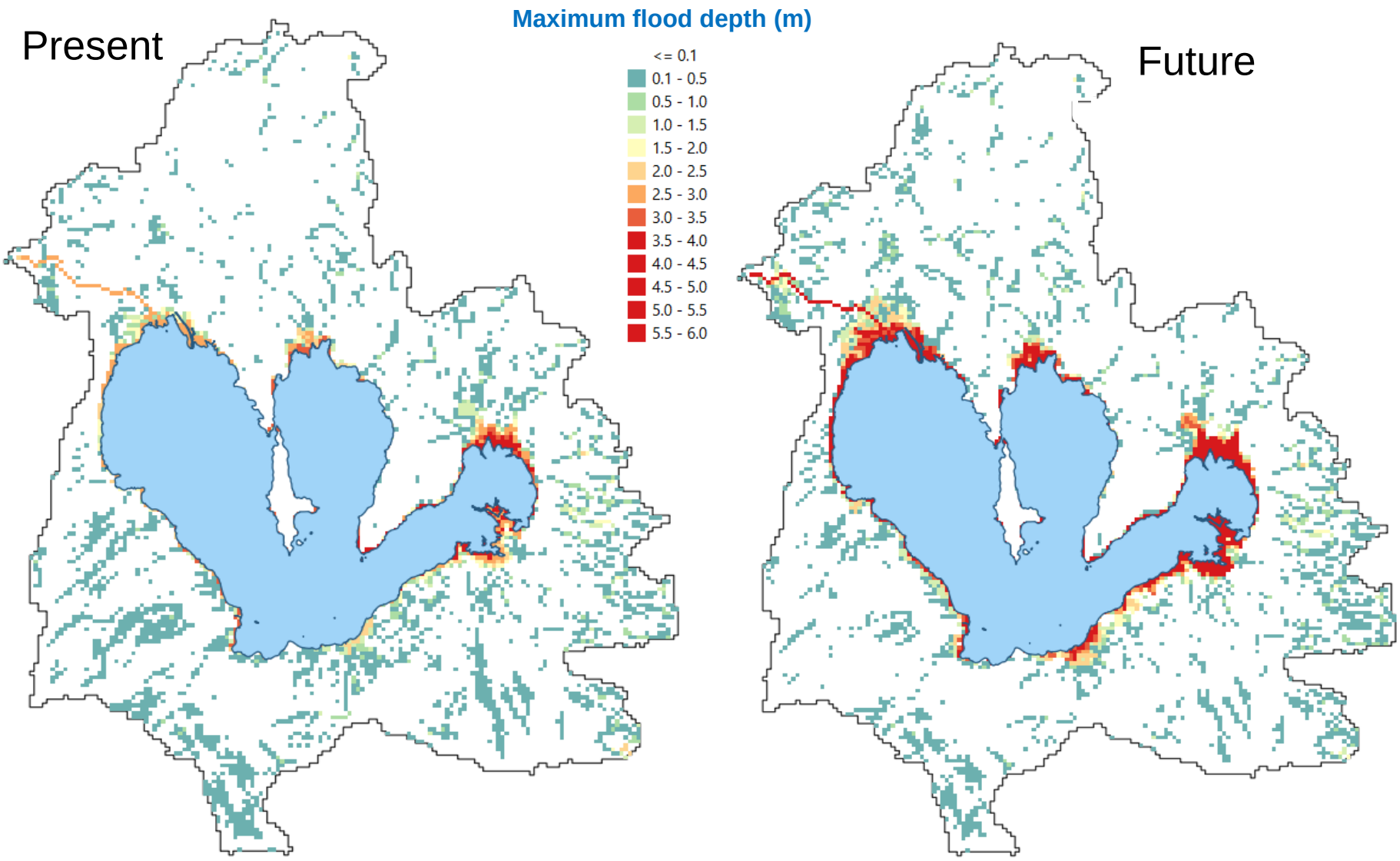


Lake level

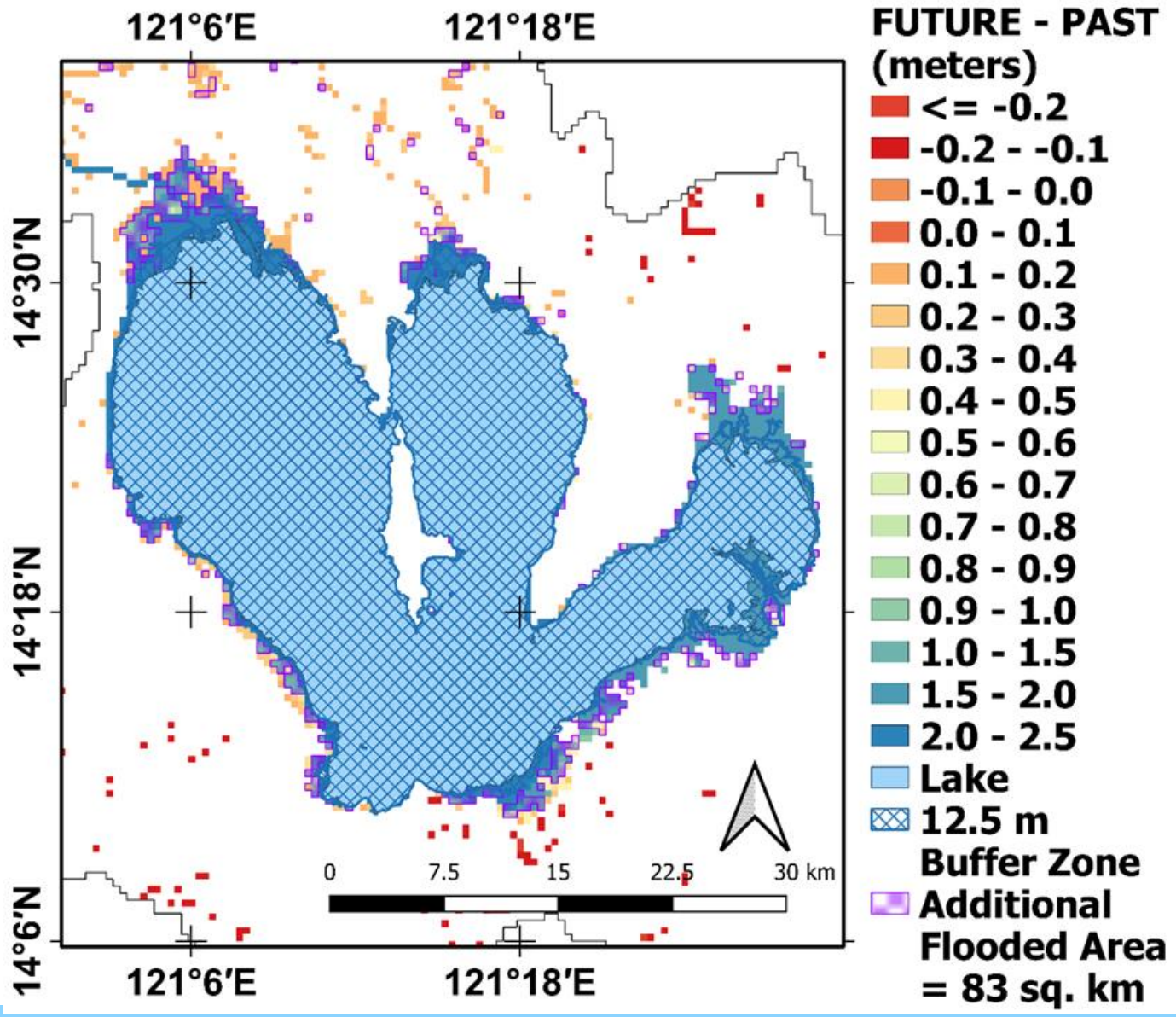
Flooding will increase from six (present climate) to 17 times in the future climate, with a maximum depth of 15.9 meters.



Change in maximum flood depth over 25 years



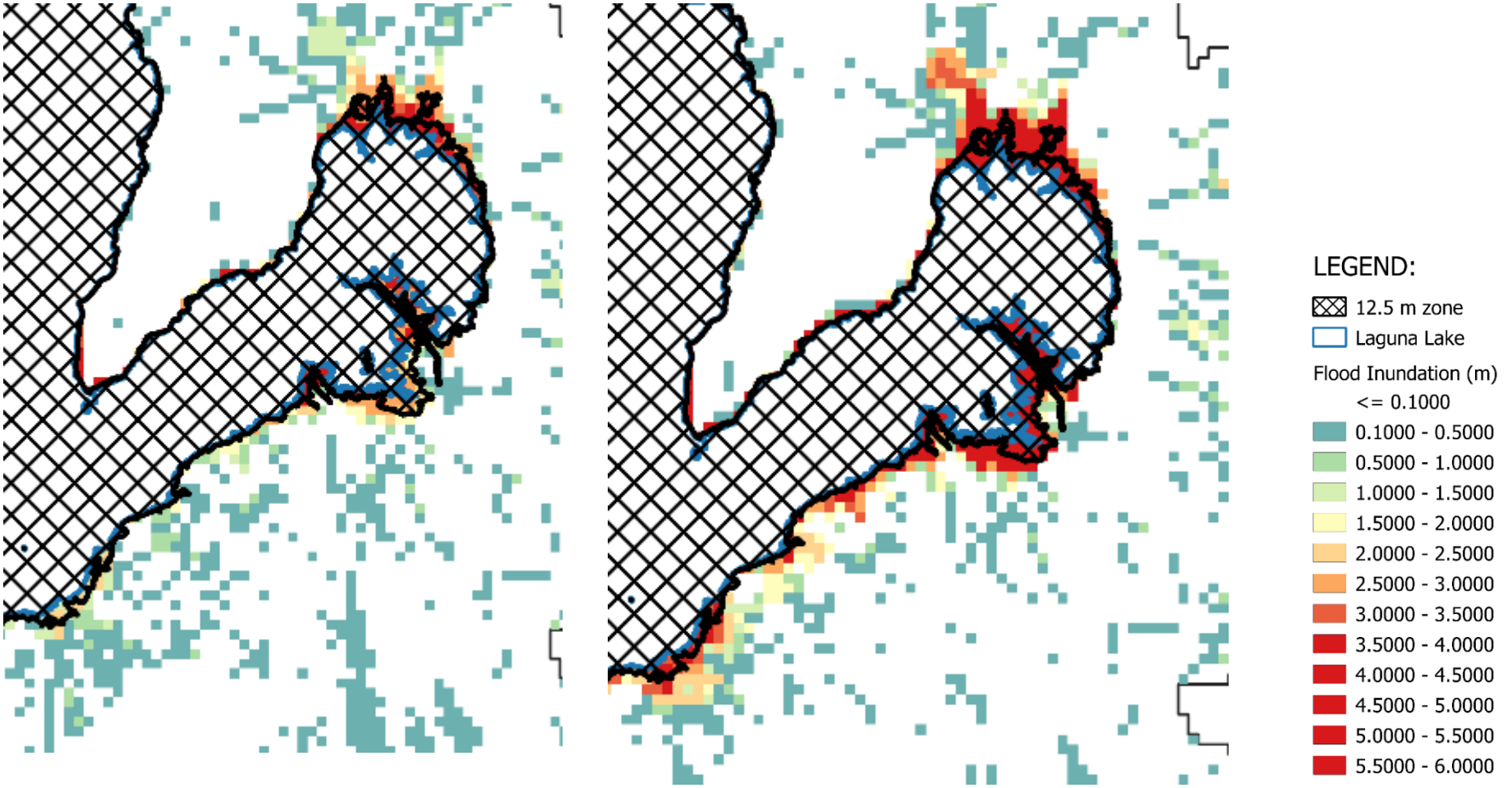
Difference of change in maximum flood depth over 25 years



Change in maximum flood depth over 25 years

Present

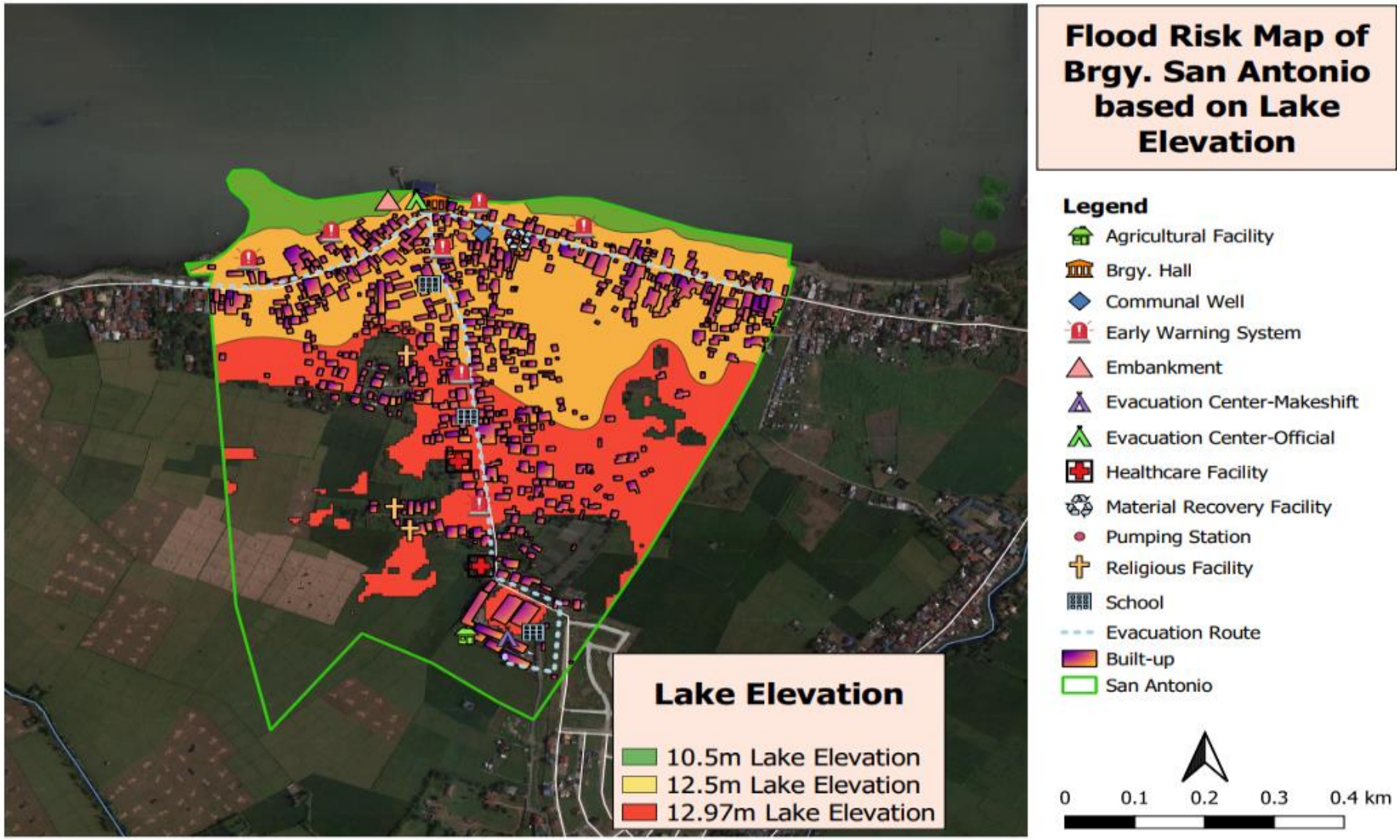
Future



Areas at an altitude of 12.5 m or below are considered unsuitable for habitation.
→ Under climate change, areas above 12.5 m will also be at risk of flooding.
→

Example of building distribution in the Laguna lakeside community

Plot results by the Philippine side project members

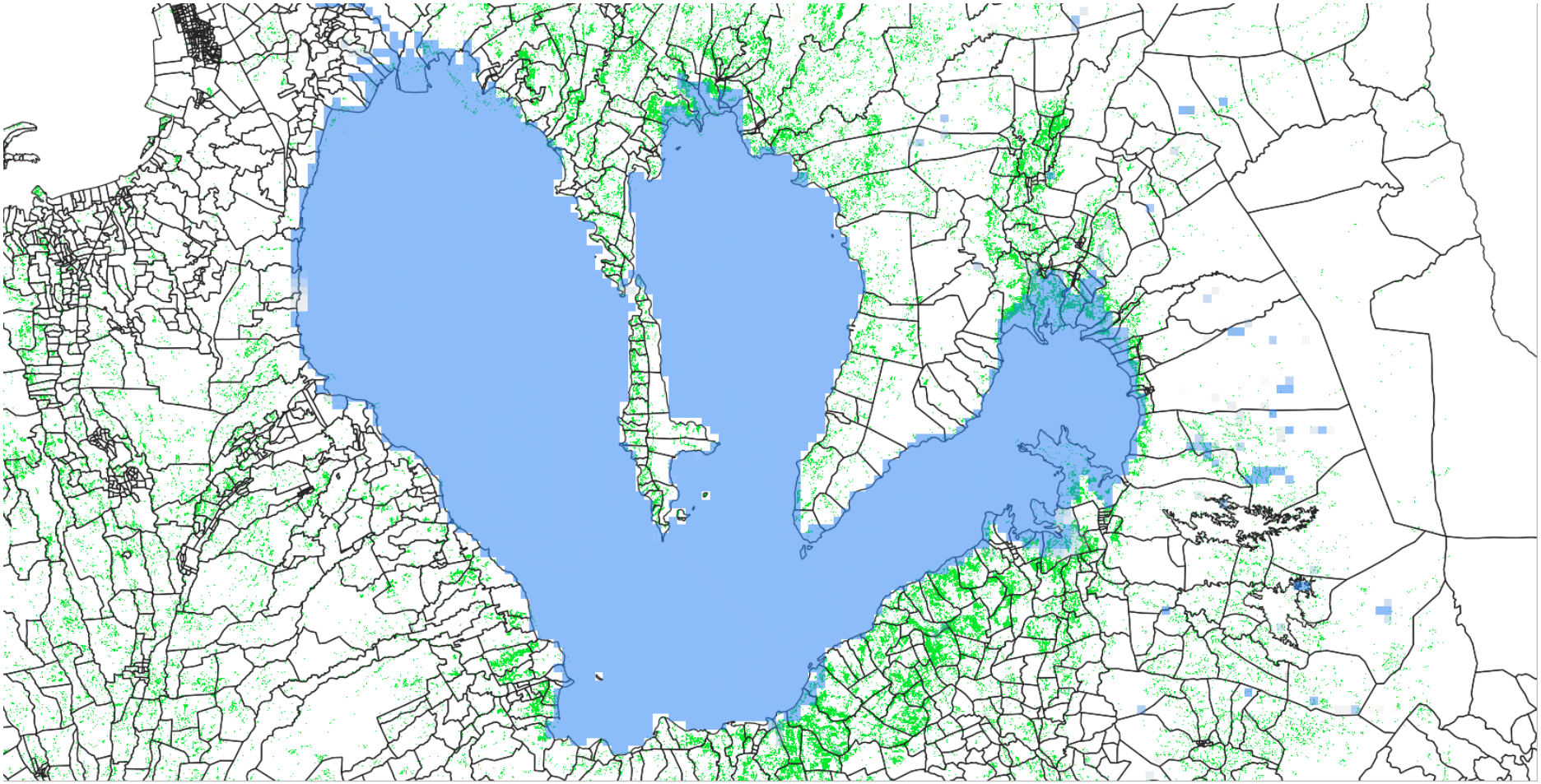


Land use management to avoid future regrets

Present	Future	Measures (private buildings)	Measures (public buildings)	Farmland
No risk	No risk	• Active land utilization	• If the area is adjacent to a flood-predicted area, priority will be given to the construction of evacuation facilities.	• Active land utilization
No risk	Risk (low)	• Control of future urbanization • Promotion of high floor and two-story buildings	• Existing: Promotion of countermeasures	• Future changes in the planting period • Selection of varieties
Risk (low)	Risk (high)	• Promotion of relocation • Further promotion of countermeasures for residents (High floor and two-story buildings, etc.)	• Existing: Promotion of countermeasures Consideration of relocation • New: Construction restrictions	• Future changes in the planting period
Risk (high)	Risk (The second floor is also at risk.)	• Active promotion of relocation	• Existing: Promotion of countermeasures Active consideration of relocation • New: Construction restrictions (strong regulations)	• Abandonment of farmland use in the future

Further consideration is needed regarding the criteria and thresholds.

Flood risk to farmland (rice fields)



Project aims

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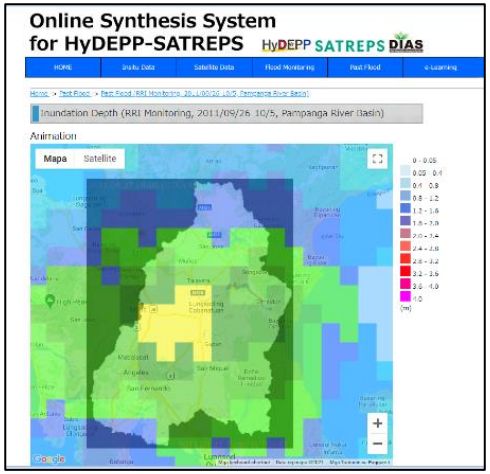
  Continuing to use research results and data even after the project ends

E-learning on an online knowledge integration system

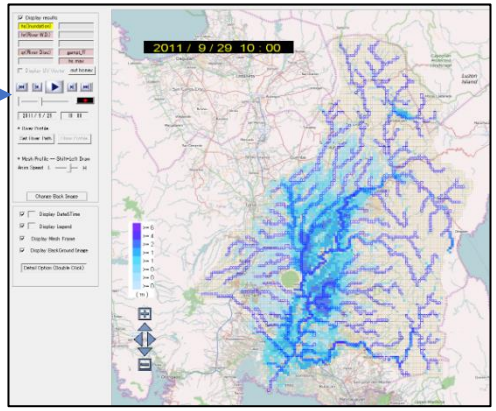
LMS System: OSS-SR System

Archive of real-time and past observation data, and flood analysis results

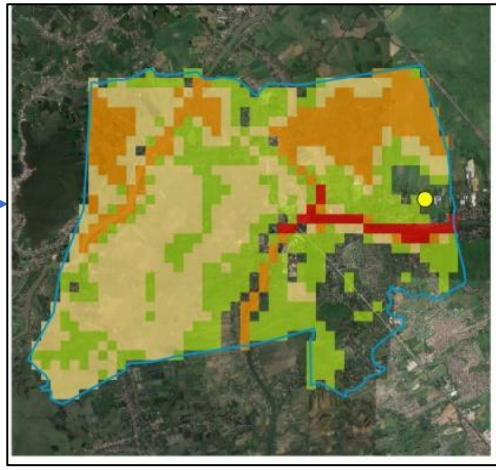


Download input data for flood and inundation analysis

Step 2: Flood and inundation analysis exercise



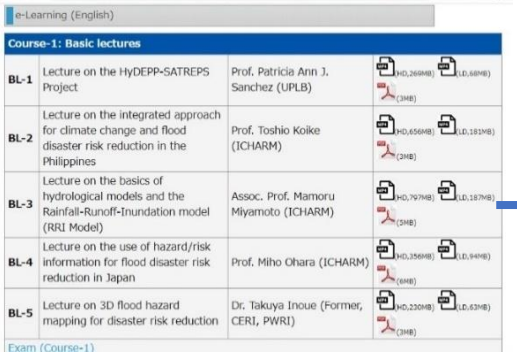
Step 3: 2D hazard map creation exercise



Step 4: 3D hazard map creation exercise using Google Earth

Step 1: Watching lecture videos

E-learning contents



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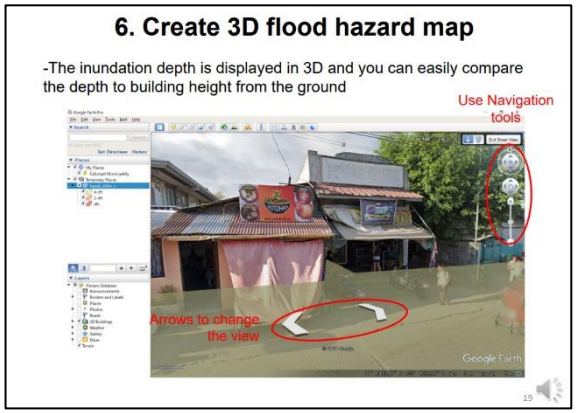


Step 5: Community disaster risk analysis

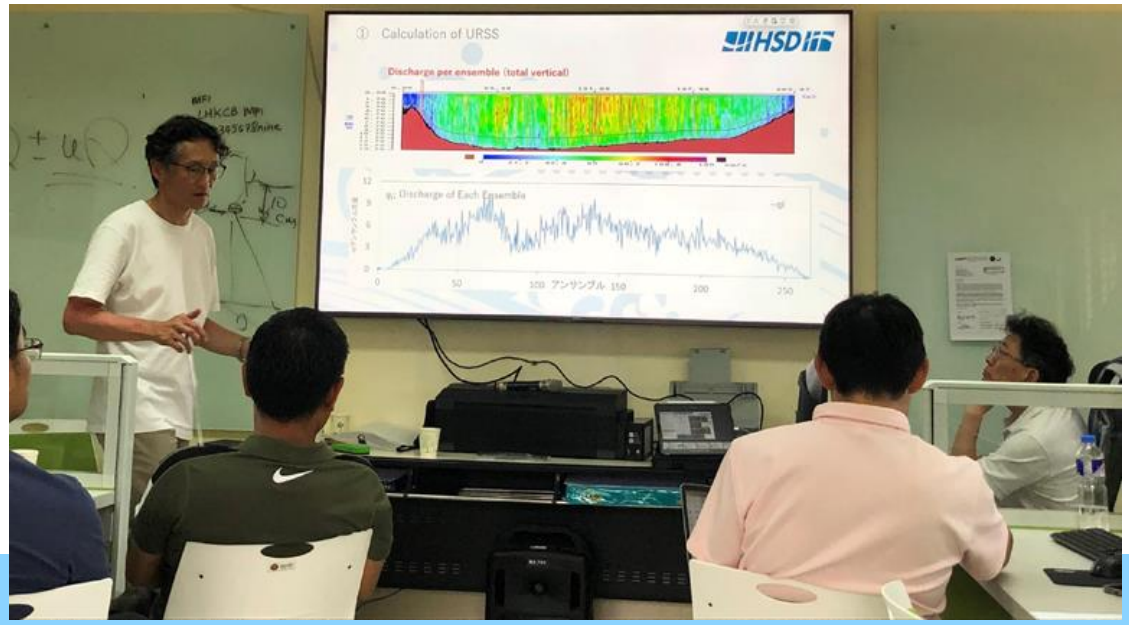
Low and high resolution videos available

Face-to-face human resource development (training in Japan)

Filipino project members visiting Japan for training

Face-to-face human resource development (on-site training) + technological environment development

Discharge observation training

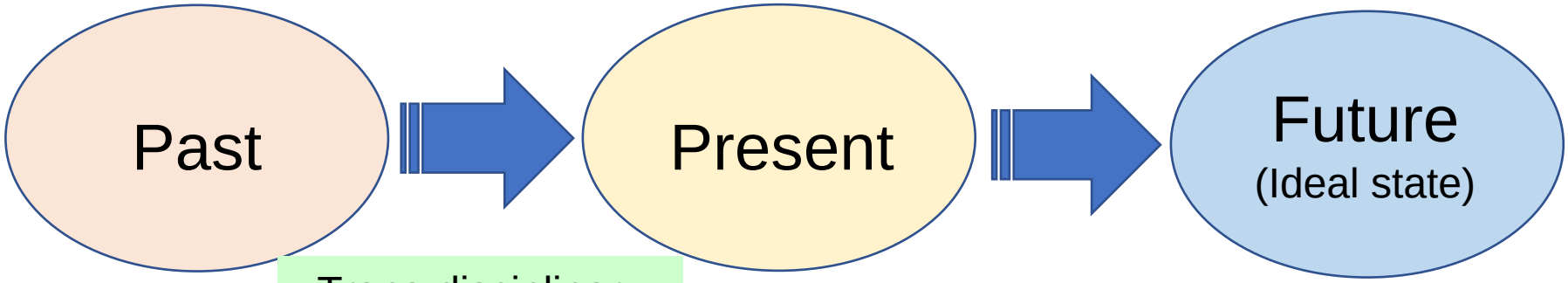


Past, present, and future: Thinking from the viewpoint of flood disaster

○ Depending on data and experience for
- Disaster prediction
- Damage estimates
- Learning lessons

Building a risk-informed society

Considering climate/social changes in the future



Trans-disciplinary water disaster risk assessment technology

○ Anticipating the future situation

↓

Take charge of designing and realizing a society to avoid future regrets!