

30 November 2022, Online

TRCG Special Session, The 17th Integrated Workshop, ESCAP/WMO TYPHOON COMMITTEE  
“Tropical Cyclone Planning, Forecasting and Response Services for Early Warning and Early Action”

# ENHANCEMENT OF FLOOD RESILIENCE BY PLATFORM ON WATER RESILIENCE AND DISASTERS

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**Associate Professor**

*National Graduate Institute for Policy Studies (GRIPS)*



# GLOBAL COOPERATION



## International Flood Initiative (IFI)

International Flood Initiative (IFI) is a joint initiative in collaboration with such international organizations as UNESCO-IHP, WMO, UNIDRR, UNU, IAHS and IAHR since 2005. ICHARM is the secretariat of IFI.

### IFI Partners



Support

## Platform on Water Resilience and Disasters

### Objective components (6)

- Data integration
- Climate change
- Economic assessment
- Flood forecasting
- Sediment disaster
- Contingency planning

## Global Agendas



Sendai Framework for Disaster Risk Reduction 2015-2030



PARIS2015  
UN CLIMATE CHANGE CONFERENCE  
COP21-CMP11  
Paris Agreement

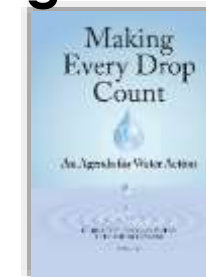


Sustainable Development Goals (2016-2030)



UN International Decade for Action: Water for Sustainable Development (2018-2028)

## High Level Panel on Water (UN/WB)



12 world leaders issue clarion call for accelerated action on water

Outcome document (14 March 2018)

“Platform on Water Resilience and Disasters” is specified in the HLPW outcome document.

# OUTCOME DOCUMENT OF HLPW

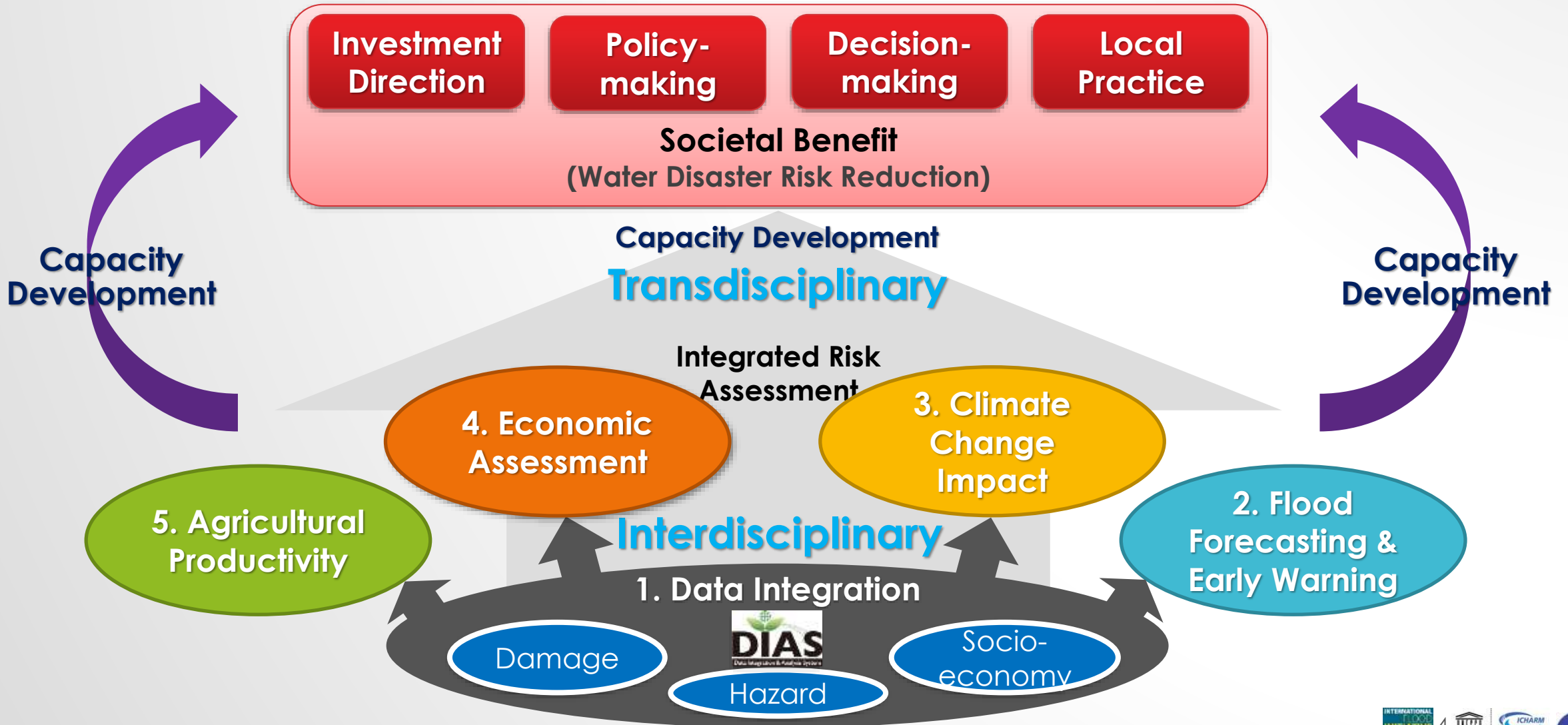
Key Recommendations  
**INTEGRATED  
AGENDA**

(P24)

Sendai Framework) in an integrated manner. Platforms on Water Resilience and Disasters among all stakeholders should be formulated in countries to facilitate dialogue and scale up community-based practices.

- ◆ Disaster risk prevention and resilience should be integrated in long-term planning.
- ◆ Financing for and investment in water-related DRR and resilience should be doubled within the next five years. “Principles on Investment and Financing for Water-related DRR” should be used to make effective use of this increased investment and could help increasing investments in countries.

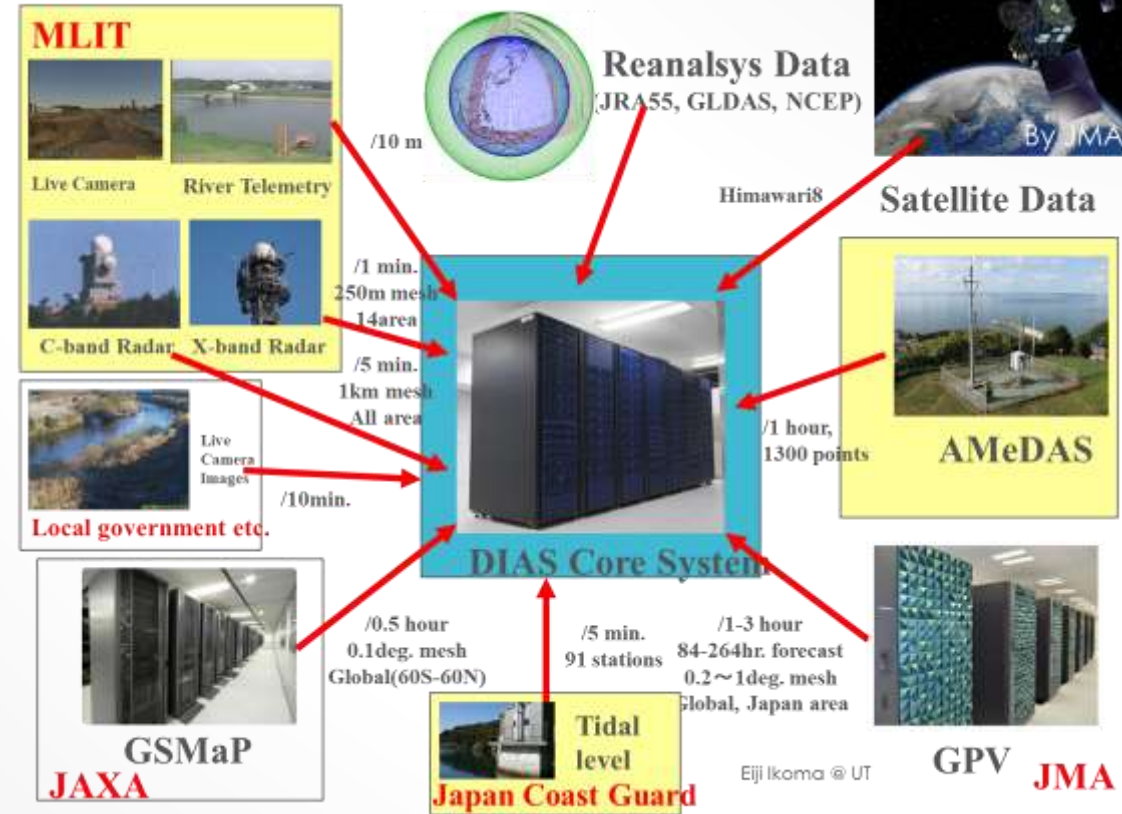
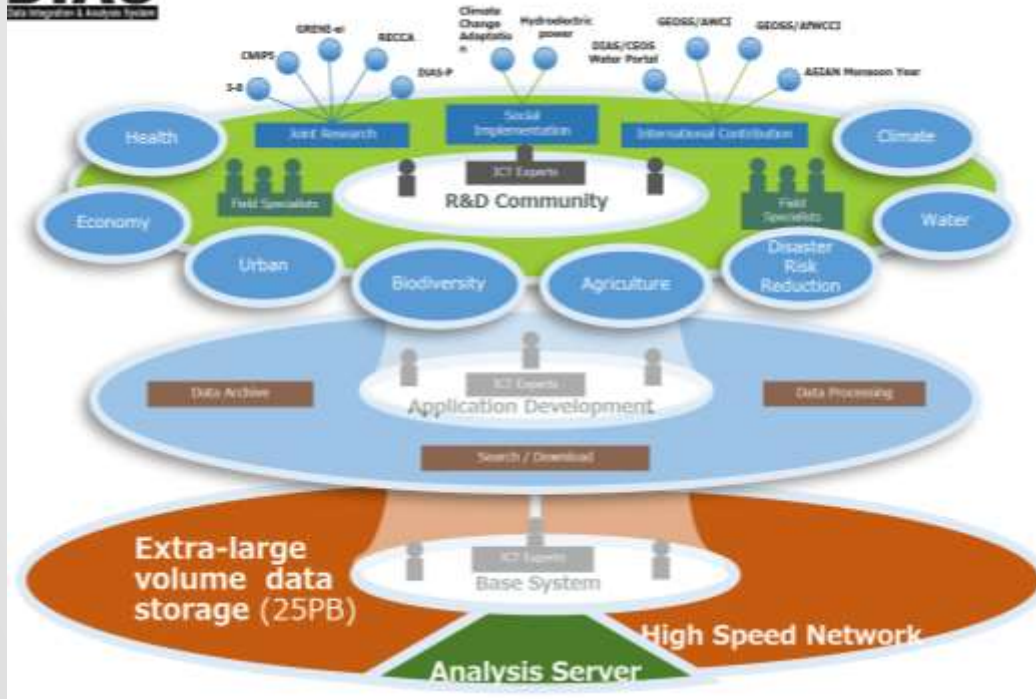
# ACTIVITY DESIGN







Challenges to variety, volume, velocity and veracity.



Data Integration  
(hazard, damage, socio-economic)

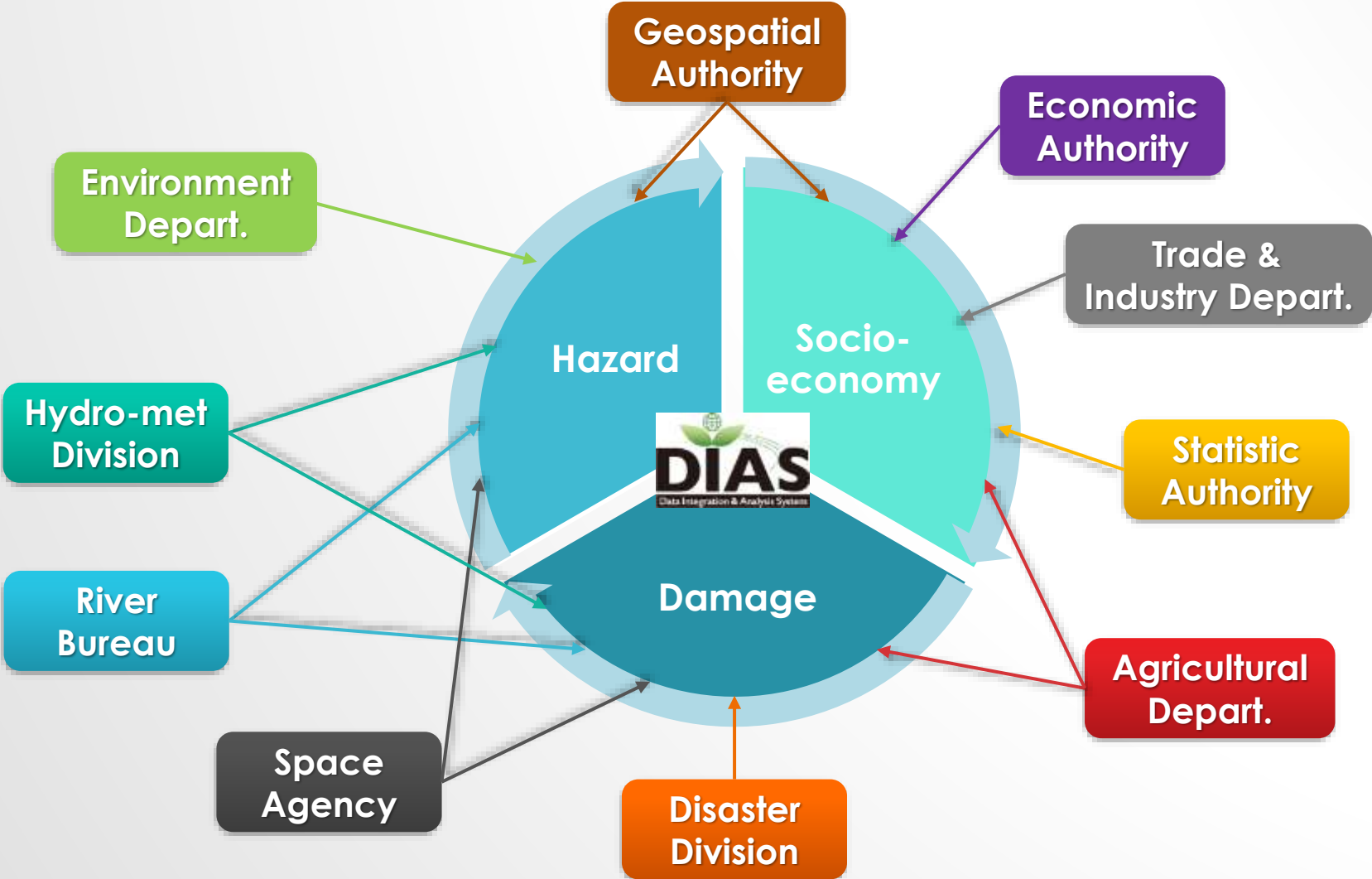
Early Warning;  
(Flood, Land Slide, Drought)

Climate Change Impact Assessment;  
(Dynamical-Statistical Down-scaling)

Economic Assessment;  
(National, Local-level)

The case in Japan

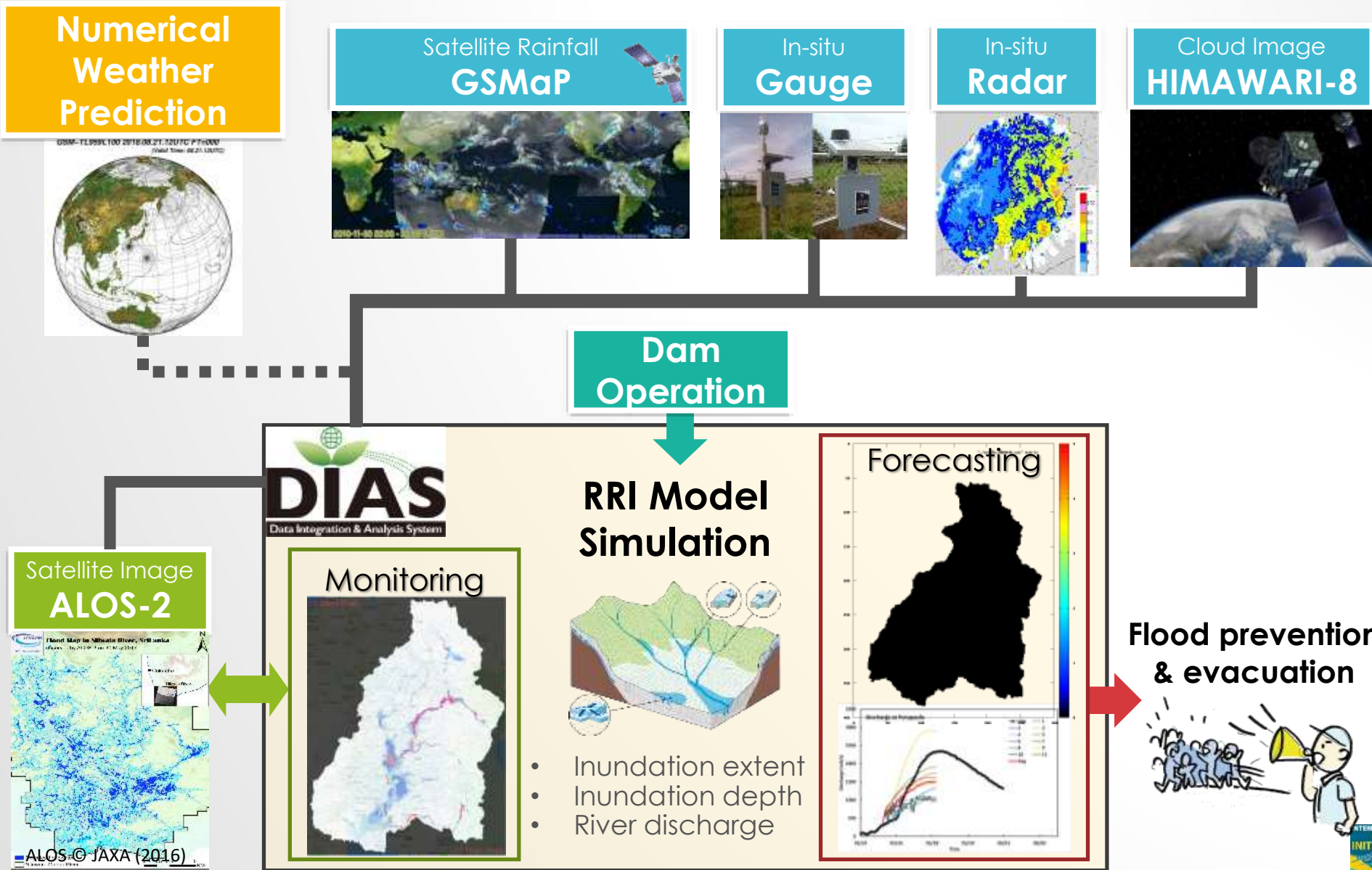
# DATA INTEGRATION



**Overall**

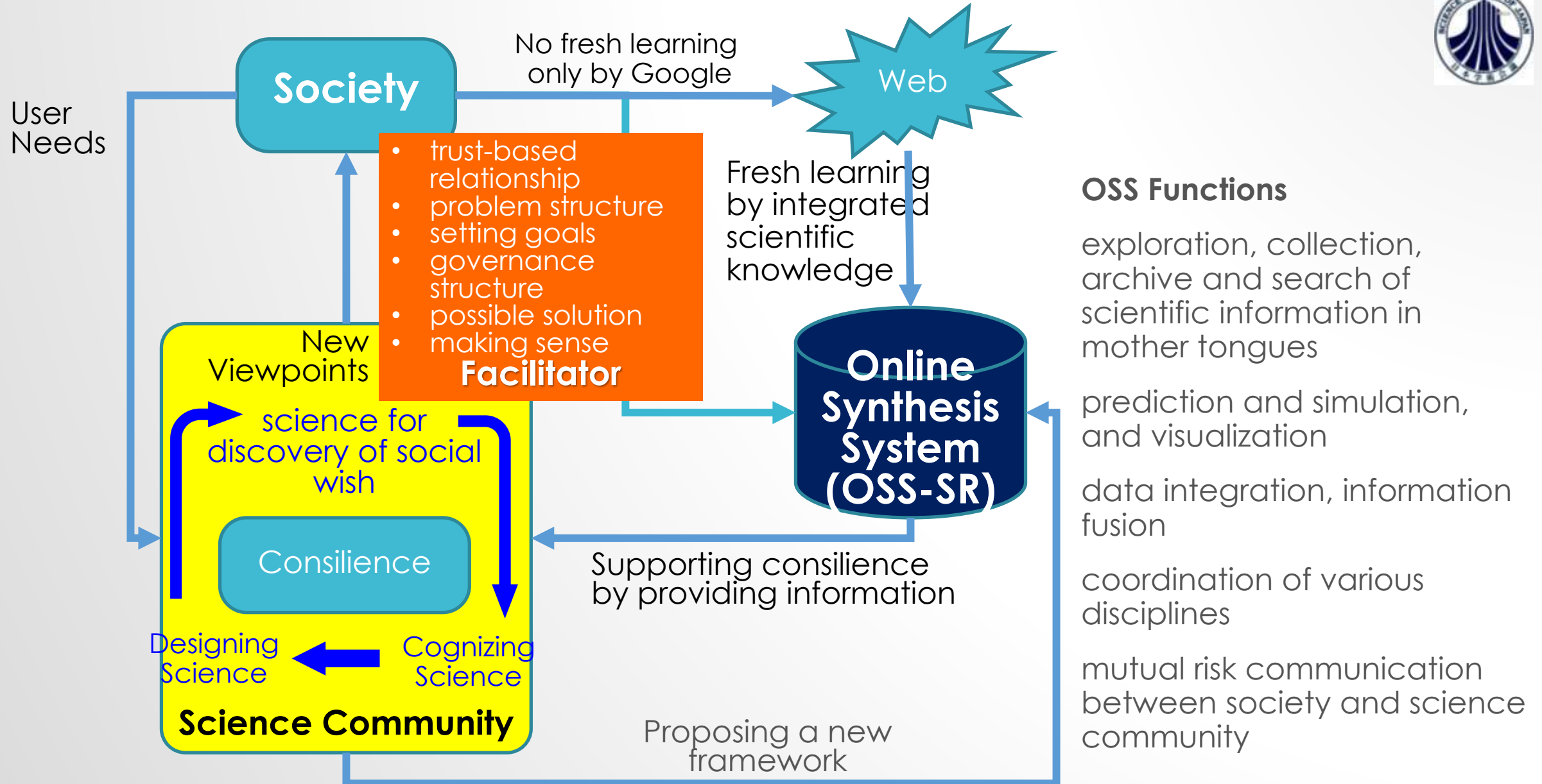
- Sci. & Tech. Dept.
- LGU

# RESEARCH: FLOOD FORECASTING & EW





# CONCEPT OF OSS-SR AND FACILITATOR





# Platform on Water Resilience and Disasters

**Pakistan**  
- Indus River Basin



**Myanmar**  
- Bago River Basin  
- Sittaung River Basin



**Philippine**  
- Pampanga River Basin  
- Davao River Basin

**Sri Lanka**  
- Kalu River Basin  
- Kelani River Basin  
- Malvathu River Basin



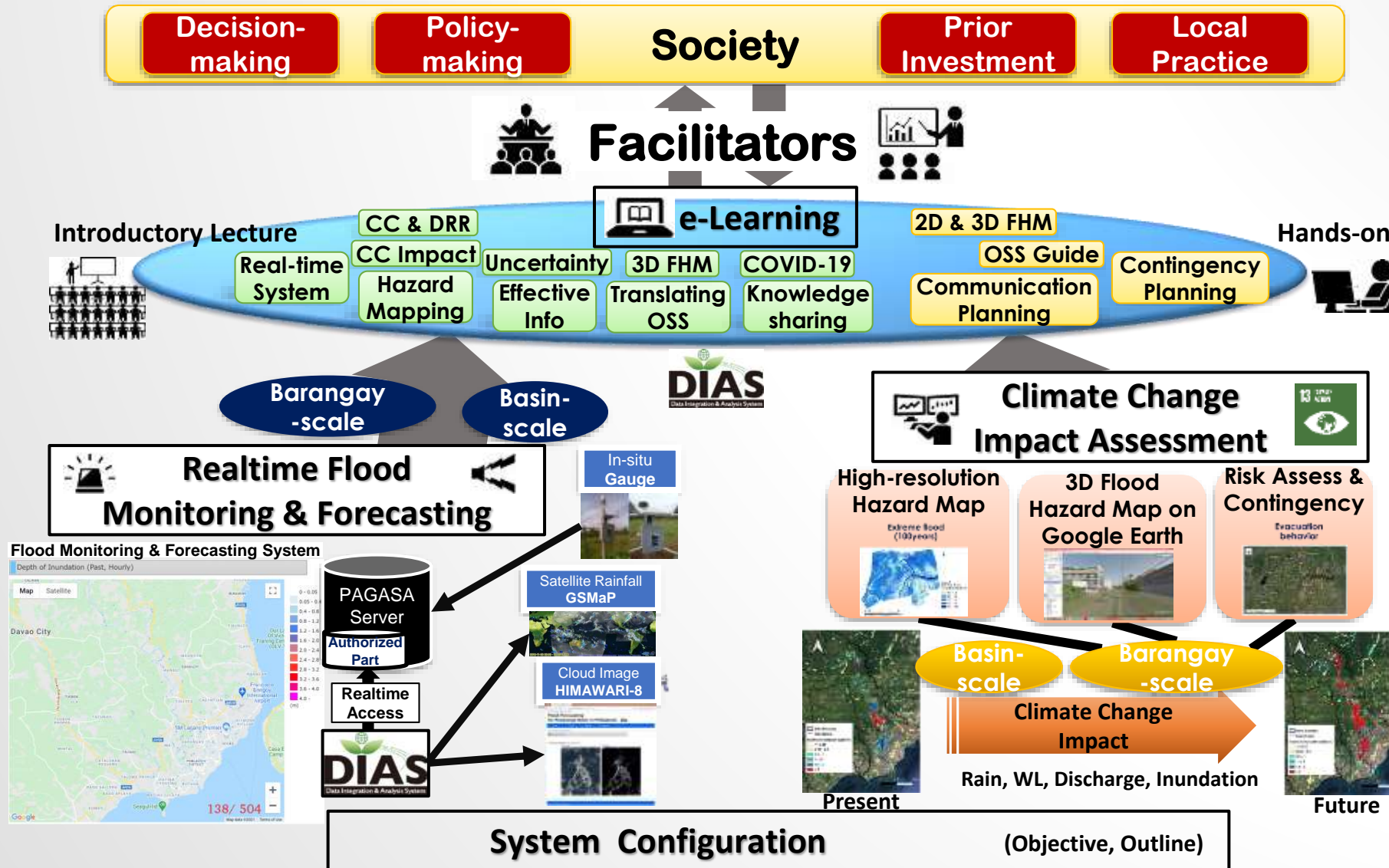
**Indonesia**  
- Bengawan Solo River Basin





# CONSILIENCE AND FACILITATORS

## Online Synthesis System for Sustainability and Resilience (OSS-SR) in Davao City, Philippines



# DAVAO OSS-SR: CONTENTS

<http://oss-davao.diasjp.net/>

Online Synthesis System for Davao City

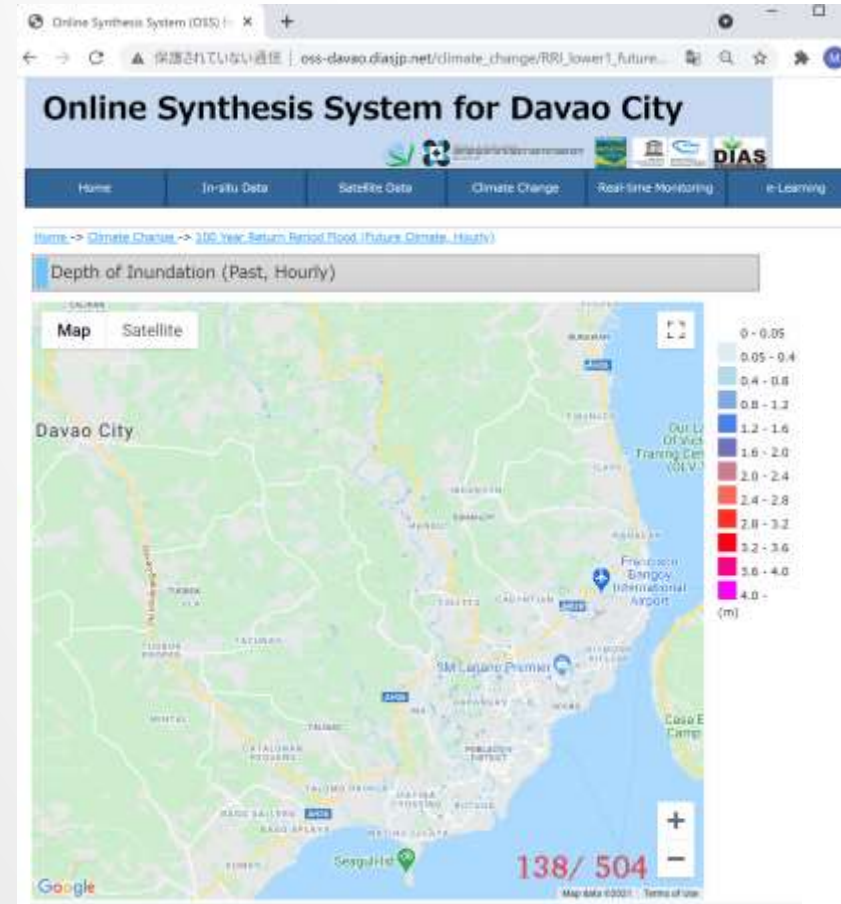
Course 1		
CC-1	Integrated Approach for Climate Change and Flood Disaster Risk Reduction in Davao	Prof. Toshiyuki Kohno
CC-2	Impact Assessment of Climate Change in Davao City	Prof. Toshiaki Uchiyama
CC-3	Uncertainty in Future Climate Change Scenarios	Dr. Kazuhiro Teranishi
FM-1	Flood Monitoring and Forecasting for the Davao River Basin	Dr. Makoto Miyamoto
FM-2	Flood Hazard Mapping and Contingency Planning for Davao City	Prof. Mitsu Ohara
FM-3	3D Flood Hazard Mapping for Disaster Risk Reduction	Dr. Takuya Inoue (CERD)
DRR-1	Effective Hazard Information & Public Awareness	Dr. Nobuyuki Tanaka (JMA)
Course 2		
DRR-2	Flood Response under COVID-19	Prof. Mitsu Ohara
DRR-3	Translating OSS knowledge into science communication plan	Prof. Della Grace Bacobas (DSSC)
DRR-4	Sharing knowledge on disaster resilience and sustainability by all	Prof. Toshiaki Kohno & Prof. Mitsu Ohara

Online Lectures

Online Synthesis System for Davao City

Local Information Map

On-site Information (ground truth)



Inundation Animation of an extreme event under future climate

Online Synthesis System (OSS) for Davao City

Brief Implementation Plan for Adaptation Measures of Climate Change -Davao City, Philippines-

Background

Strengthening Disaster in Under the concept of SDG11, from the perspective of disaster management capacity.

Objectives

- To develop an Online related disasters by technology for relief academics, and farmer
- To foster facilities disaster resilience at
- To disseminate the

Rain Map Viewer

GSMaP-NOW 2021.11.04 1630\_1729 (UTC)

Real-time Information (ex. GSMaP)



# DAVAO OSS-SR: MODELING APPROACH

- Real-time Monitoring & Forecasting

Online Synthesis System for Davao City

Home | In-situ Data | Satellite Data | Climate Change | Real-time Monitoring | e-Learning (English)

Home -> Real-time Monitoring

		Davao River basin
Real-time	Whole Basin	<a href="#">Inundation</a>
		<a href="#">River Discharge</a>
	Focused Area	<a href="#">Barangay Mandug (Inundation)</a>
		<a href="#">Barangay Ma-A (Inundation)</a>

## Discharge Hydrograph

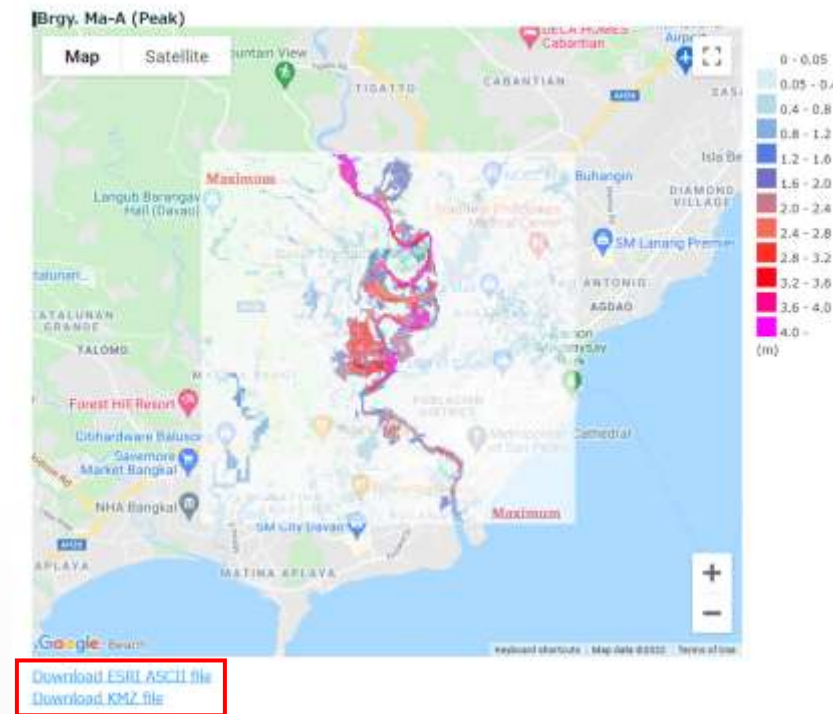
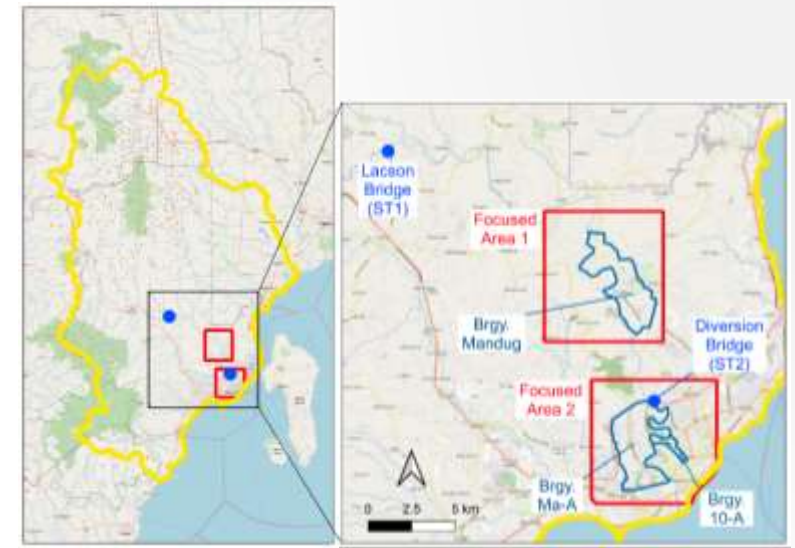
- **Time-series:** 24 hours @Lacson Bridge
- **Time-series:** 10 days hourly @Lacson Bridge
- **Time-series:** 24 hours @Diversion Bridge
- **Time-series:** 10 days hourly @Diversion Bridge

## Inundation Map

- **MAP:** The latest depth
- **Animation:** last 24 hours
- **MAP:** 10 days maximum

## Inundation Map

- **MAP:** The latest depth
- **Animation:** last 24 hours
- **MAP:** 10 days maximum



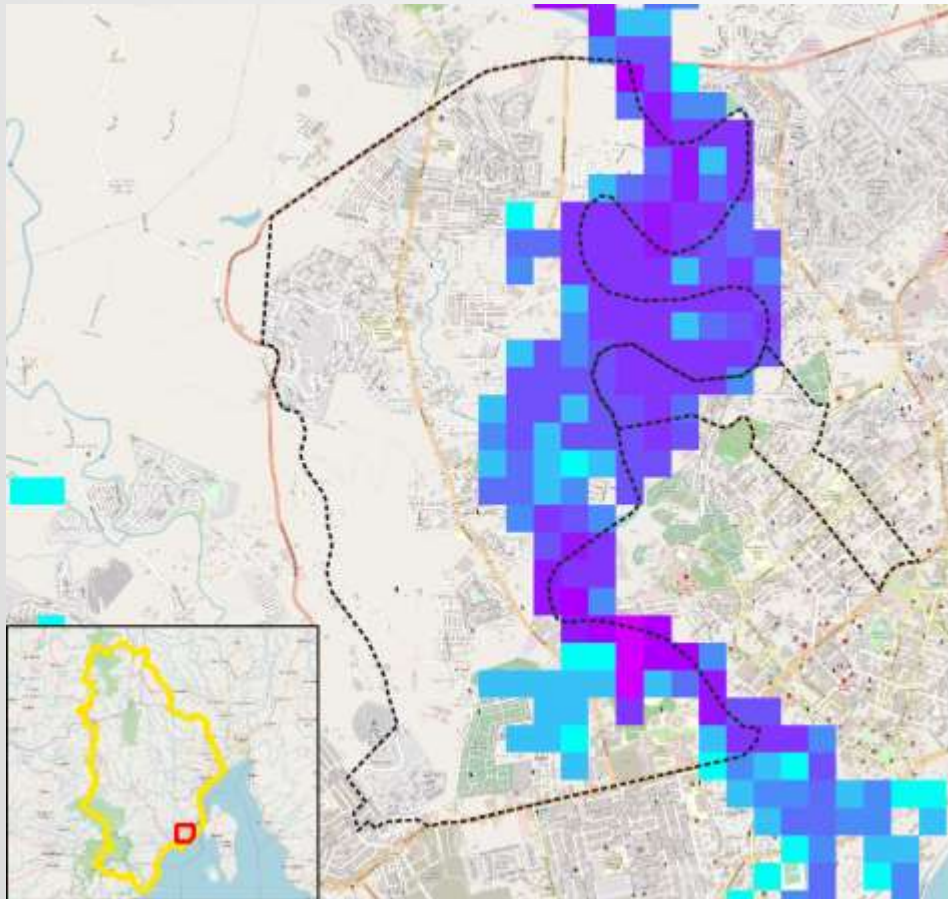
ASCII file is downloadable



# DAVAO OSS-SR: MODELING APPROACH

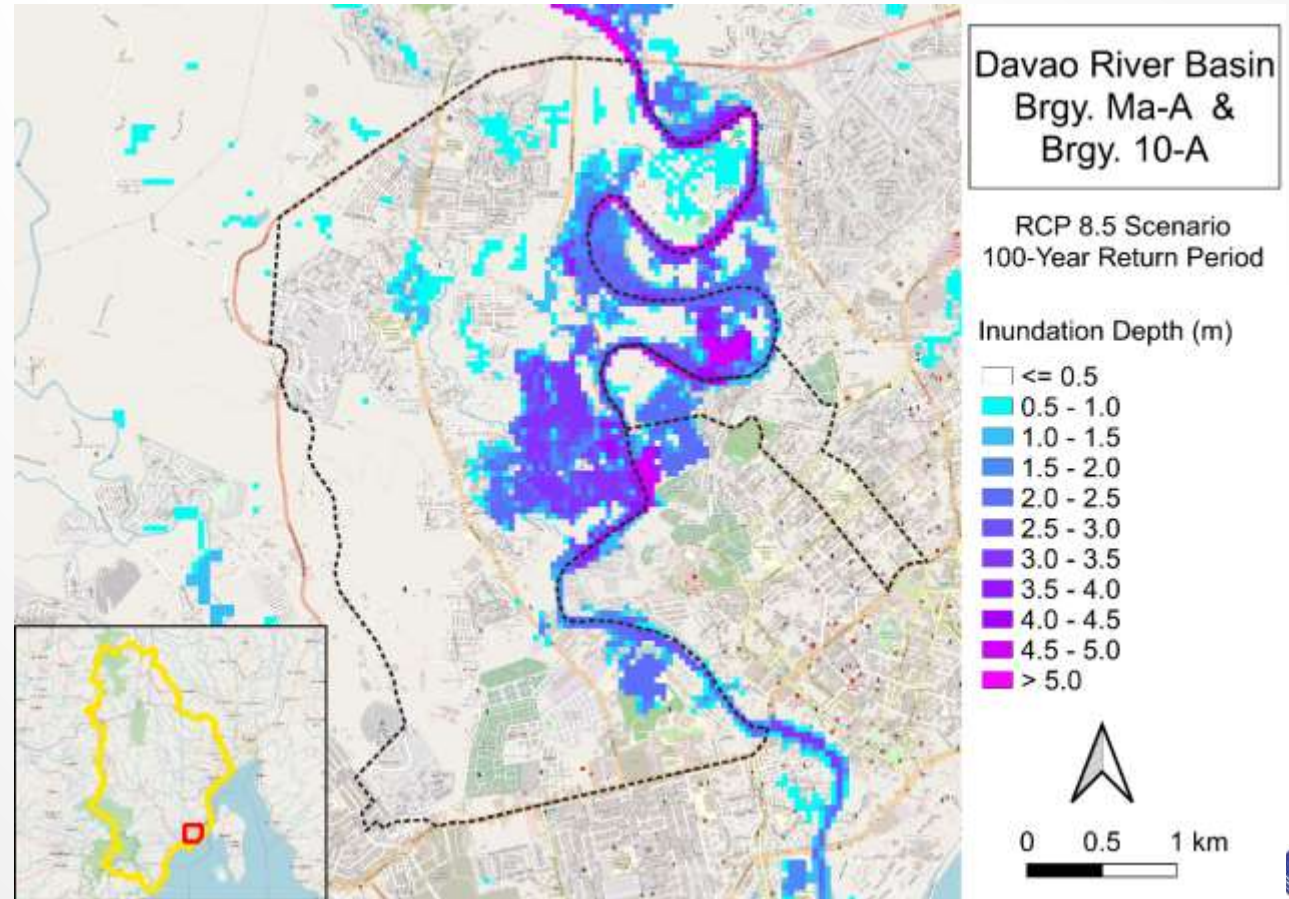
## Basin-scale model

Resolution: 6 arc second  $\approx$  180 m

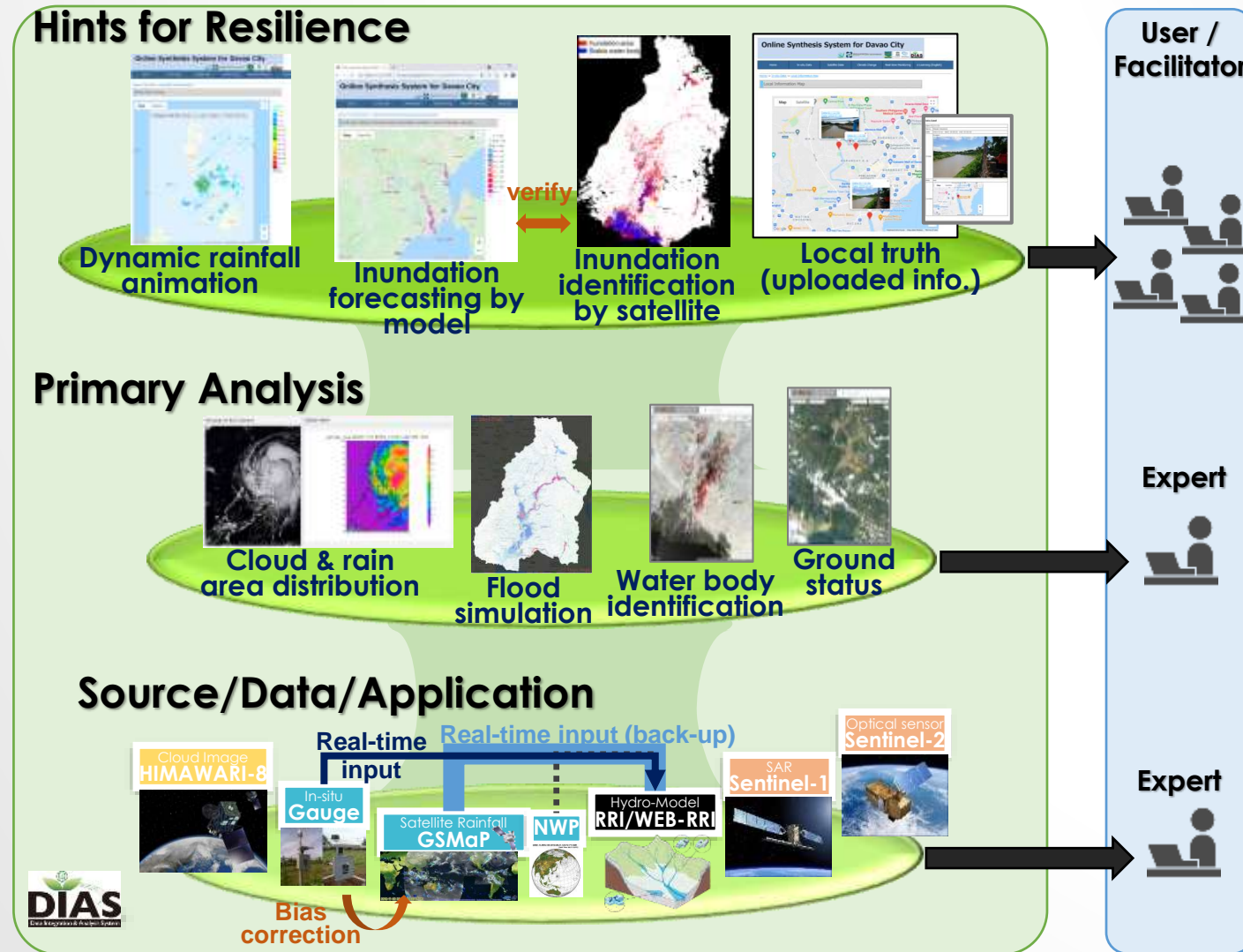


## Barangay-scale model

Resolution: 40 m



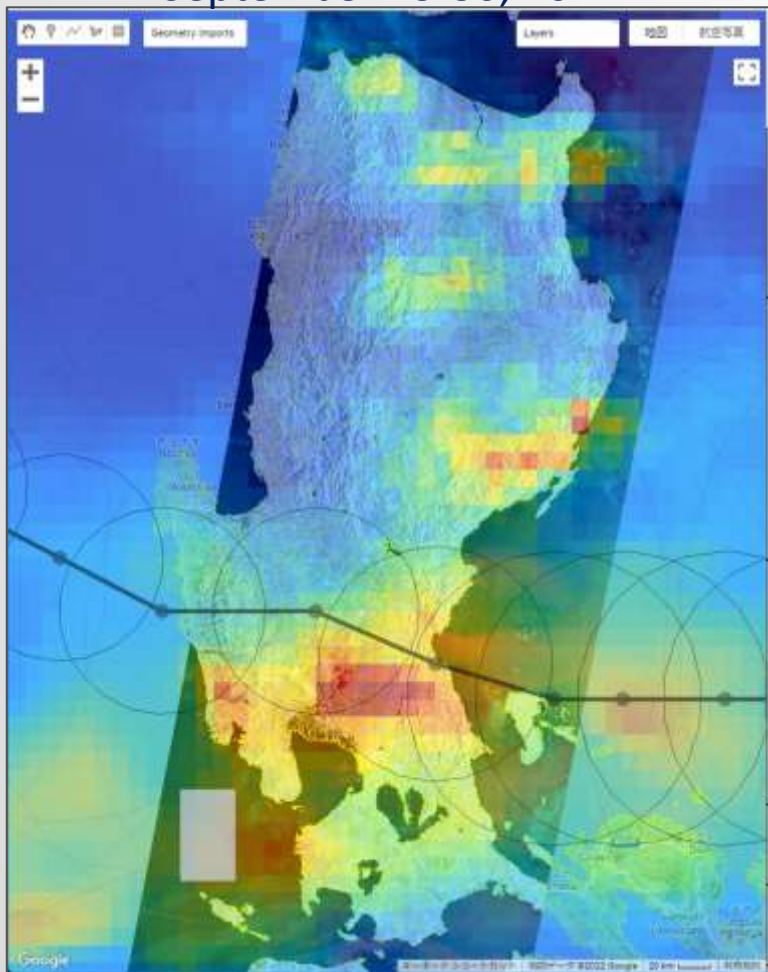
# OSS-SR: REAL-TIME FORECASTING



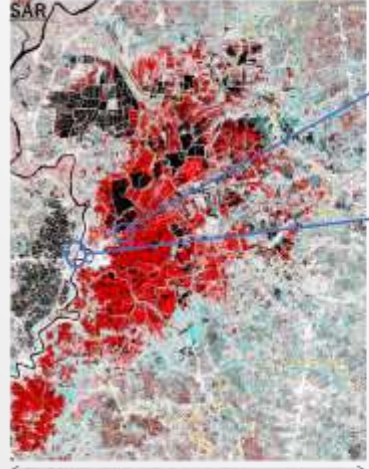


# THE CASE OF TYPHOON NORU, SEPTEMBER 2022

Track of Typhoon Noru,  
September 23-30, 2022



Inundation area on Oct-1 by Sentinel-1 SAR



R : G : B = before : after : after



**Meaning of the coloring for the RGB composite image**

- The preserved water surface from before. [Before - After]
- Ongoing inundation (the spread water surface from before). [Before - After]
- Withdrawn inundation; soil moisture and/or surface roughness increasing, flooding under vegetation/forest, etc. [Before - After]
- The preserved land surface from before. [Before - After]



A : Hardly inundated (right bank of the Pamanga)  
B : Hardly inundated (swamp margin)  
C : Hardly inundated (higher topography)  
D : Sometimes inundated (large flood)  
E : Usually inundated



Inundation depth at each barangay hall

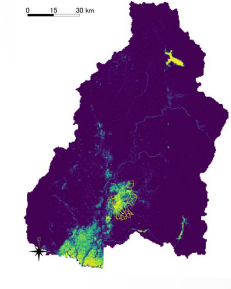
Barangay	Depth (m)
Buhay Fave	1.44
Camaligan	1.42
San Isidro	1.42
Puerto Rico	1.42
San Pablo	1.42
San Juan	1.42
San Pedro	1.42
San Antonio	1.42
San Jose	1.42
San Marcos	1.42
San Andres	1.42
San Francisco	1.42
San Rafael	1.42
San Blas	1.42
San Felipe	1.42
San Carlos	1.42
San Pedro de Macoris	1.42
San Mateo	1.42
San Cristobal	1.42
San Antonio de Abad	1.42
San Juan de los Rios	1.42
San Francisco de Macoris	1.42
San Blas de Noy	1.42
San Mateo de Chuahua	1.42
San Antonio de Matanzas	1.42
San Pedro de Macoris	1.42
San Mateo de Chuahua	1.42
San Antonio de Matanzas	1.42
San Blas de Noy	1.42
San Mateo de Chuahua	1.42
San Antonio de Matanzas	1.42

# Water surface by Sentinel-1 SAR



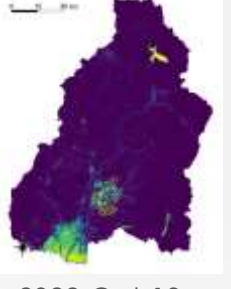
2022-Sep-19  
21:47

No data



2022-Oct-01  
21:47

No data



2022-Oct-13  
21:47

# Water surface by Sentinel-2 OPT



2022-Sep-24  
02:15

\*No analysis due to clouds

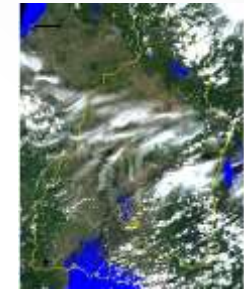
No data



2022-Sep-29  
02:15

\*No analysis due to clouds

No data/Cloud



2022-Oct-09  
02:15

No data

# RRI inundation depth [m]



2022-Sep-24  
00:00



2022-Sep-25  
00:00



2022-Sep-26  
00:00



2022-Sep-27  
00:00



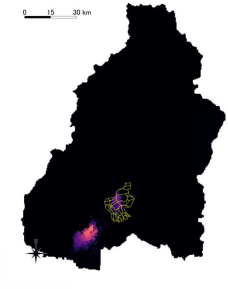
2022-Sep-28  
00:00



2022-Sep-29  
02:00



2022-Sep-30  
00:00



2022-Oct-01  
22:00



2022-Oct-09  
00:00



2022-Oct-13  
00:00

Before  
flood

Sep-25

Sep-26

Sep-27

Sep-28

Sep-29

Sep-30

Oct-01

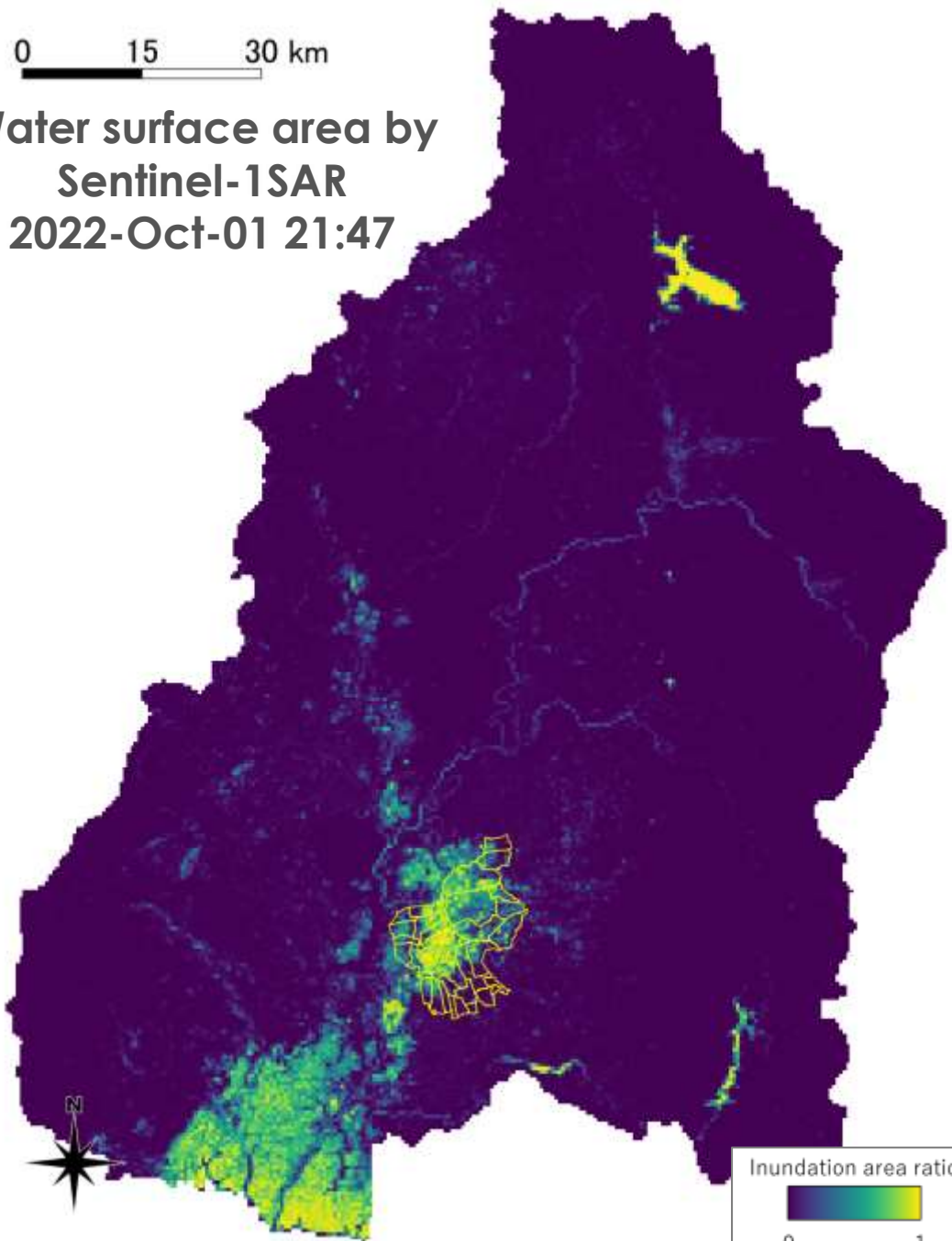
Oct-09

Oct-13



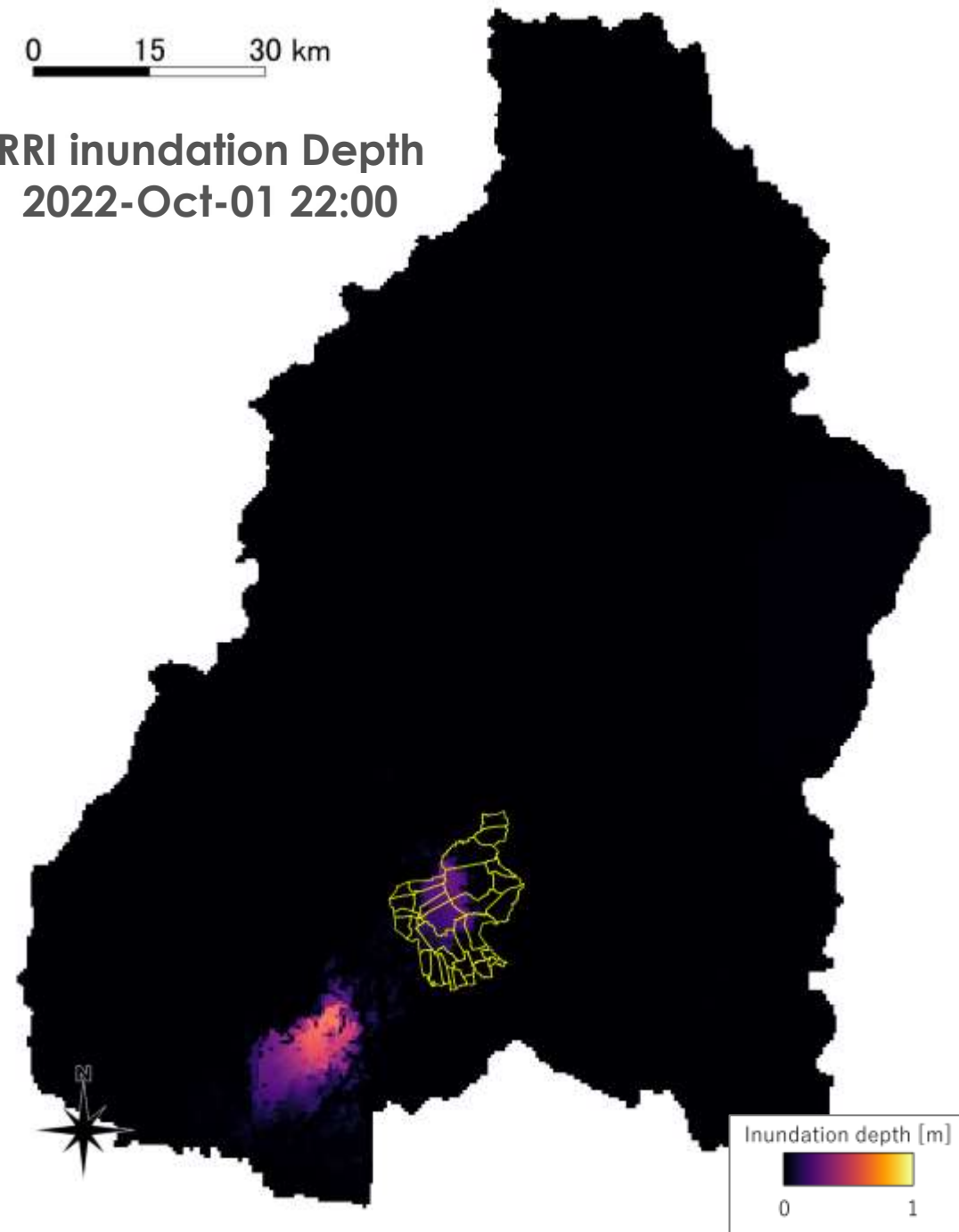
0 15 30 km

Water surface area by  
Sentinel-1 SAR  
2022-Oct-01 21:47



0 15 30 km

RRI inundation Depth  
2022-Oct-01 22:00



0 2.5 5 km

Sentinel-2 OPT  
2022-Sep-29 02:15



RRI Inundation Depth  
2022-Sep-29 02:00



Inundation depth [m]



0 1



# DAVAO OSS-SR: CLIMATE CHANGE IMPACT

## Annual rainfall

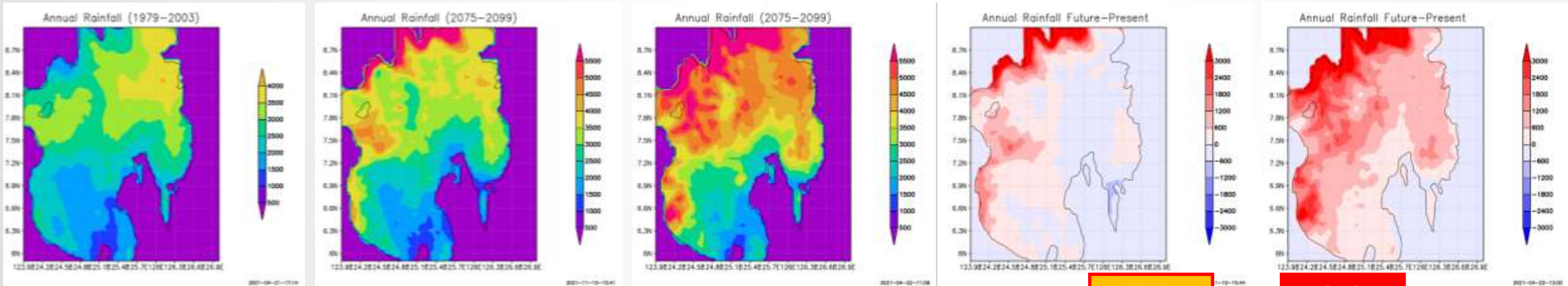
Past climate

Future (RCP2.6)

Future (RCP8.5)

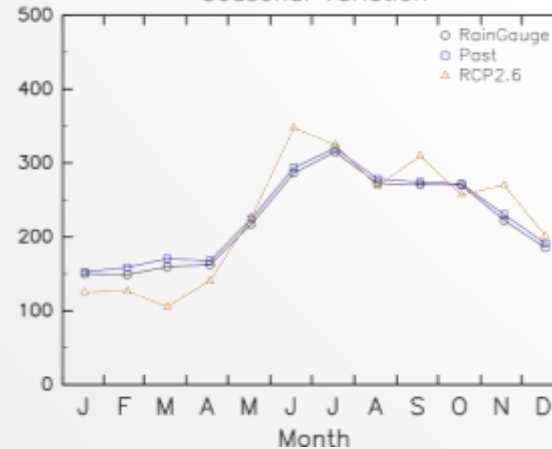
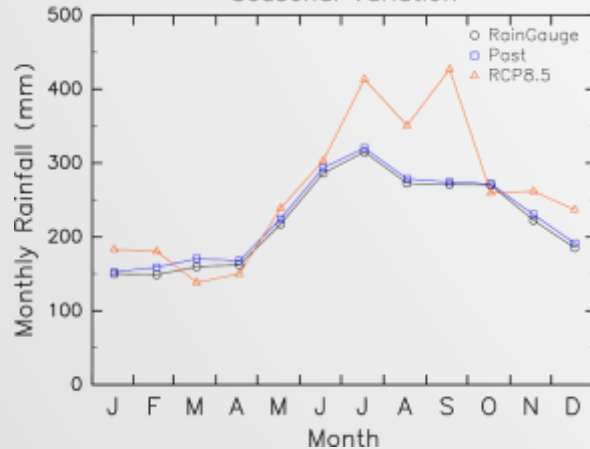
(future)-(past) RCP2.6

(future)-(past) RCP8.5

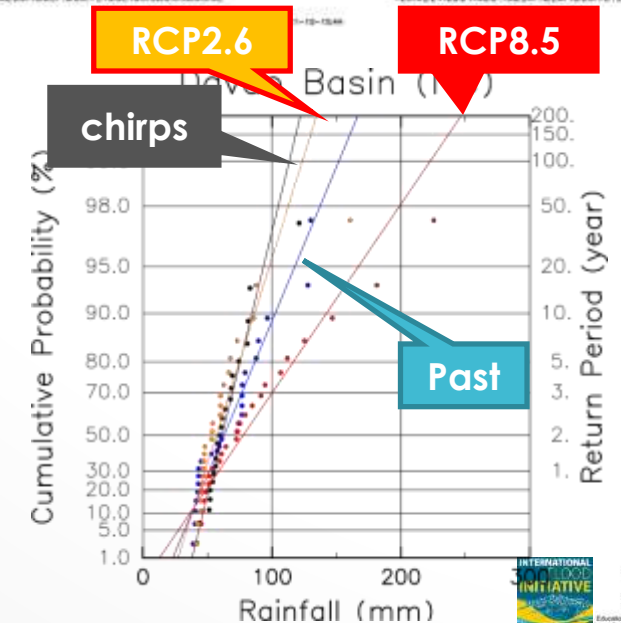


3.2H WRF RCP8.5 Seasonal Variation

3.2H WRF RCP2.6 Seasonal Variation



After Bias correction



# DAVAO OSS-SR: CLIMATE SCENARIO

## • Climate Change Impact

### Climate Change scenario

<b>Future</b> <b>(2075-2099)</b> <b>RCP8.5</b>	100year Return Period
	50year Return Period
	GCM Worst-case (225.4mm/24h)

<b>Past</b> <b>(1979-2003)</b>	100year Return Period
	50year Return Period
	GCM Worst-case (127.7mm/24h)

X

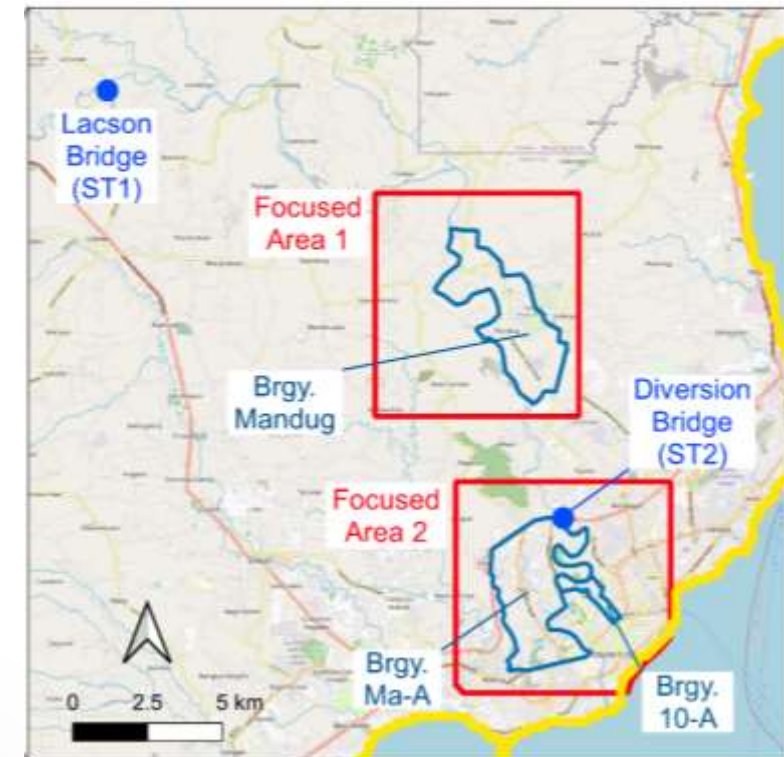
### Basin-scale Model

Model: **WEB-RRI model**  
 Resolution: **approx. 180 m**  
 Area: **3,644 km<sup>2</sup>**



### Barangay-scale Model

Model: **RRI model**  
 Resolution: **40 m**  
 Area: **50 km<sup>2</sup>**



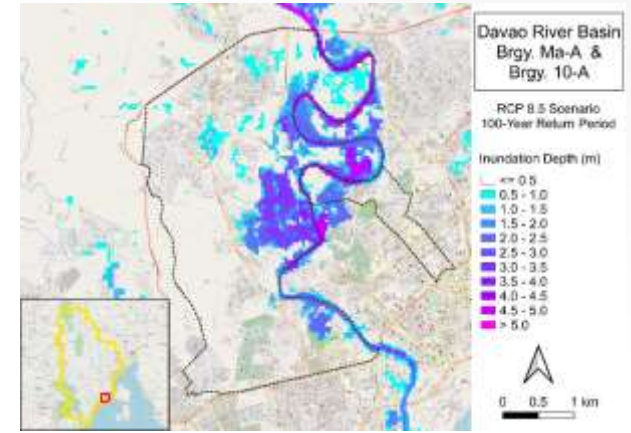
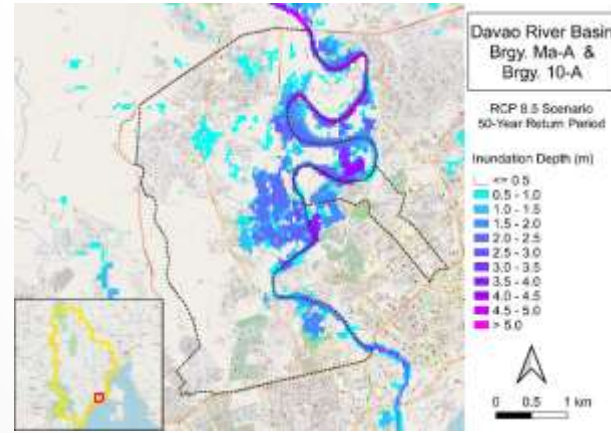
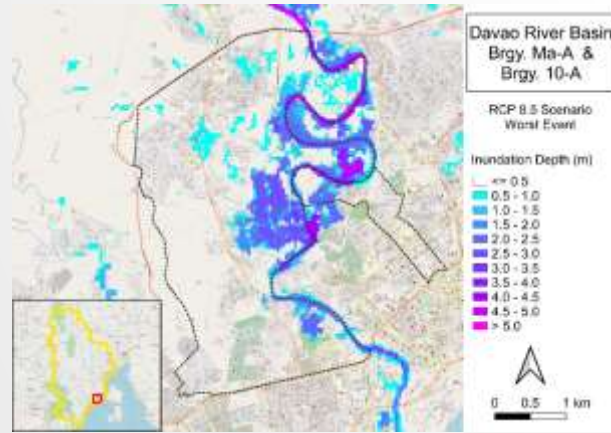


# RESEARCH: CLIMATE CHANGE IMPACT

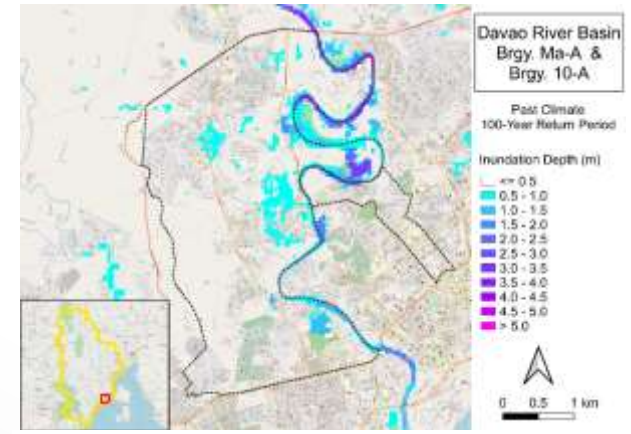
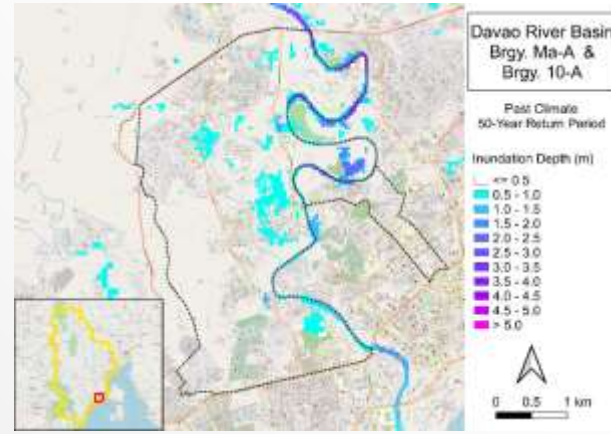
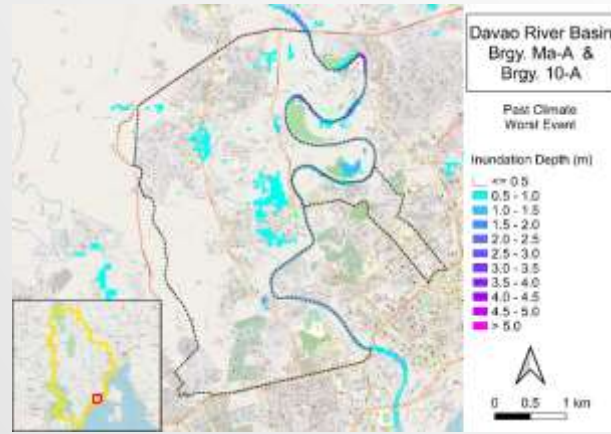
## • Climate Change Impact Assessment



**Future  
(2075-2099)  
RCP8.5**



**Past  
(1979-2003)**



GCM Worst-case

50 year Return Period

100 year Return Period

# DAVAO OSS-SR: E-LEARNING WS & TRAINING

## First Phase: e-Learning WS (introductory lecture), April 19-May17, 2021

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

## Second Phase: e-Learning WS (Hands-on Training), January 17-28, 2022

2022				
Monday	Tuesday	Wednesday	Thursday	Friday
January 17	January 18	January 19	January 20	January 21
10:00–12:00 <b>Opening Session</b>	Self-learning	Self-learning	Self-learning	Self-learning
January 24	January 25	January 26	January 27	January 28
13:00–15:00 <b>Q &amp; A Session</b>	Self-learning & submission	Due: <b>Submission</b>	Evaluation by lectures	15:00–17:00 <b>Closing Session</b>

# DAVAO OSS-SR: WS PARTICIPANTS

Candidates for the facilitator were invited from different disciplines and sectors of society.



Breakdown of Disciplines

Discipline	1st WS	2nd WS
National Government	11	10
Local Government	2	4
Academe	11	13
Civil Society Organization	1	2
Private Sector	2	1
Media	2	1
<b>TOTAL</b>	<b>29</b>	<b>31</b>

- **CRITERIA 1 (Direct disciplines):** Those who have a background in DRRM, CCA, Sustainability, IWRM, RBO management, Flood management, and Climate/meteorology
- **CRITERIA 2 (Good mix of sciences):** Natural science, Engineering, Social science including communication, ICT, and Communicator in the mother tongue.
- **CRITERIA 3 (Representation from different levels of governance):** Barangay, City/ Municipality, National government, Private sector/Industry, Civil society, Academe, Media, and Special representation from DRBMA which is an interregional body.
- **CRITERIA 4 (Local initiative):** Members of HELP Davao Network

**Co-design with  
local communities**

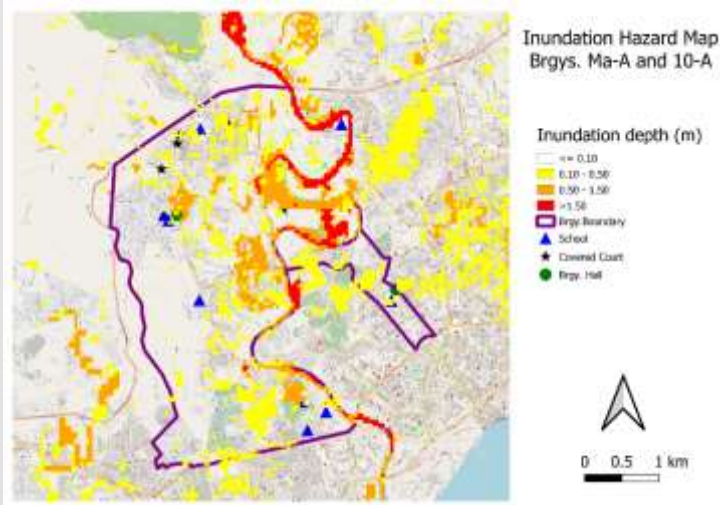


Participants in the Q & A Session



# DAVAO OSS-SR: DELIVERABLES OF TRAINING

## Present climate

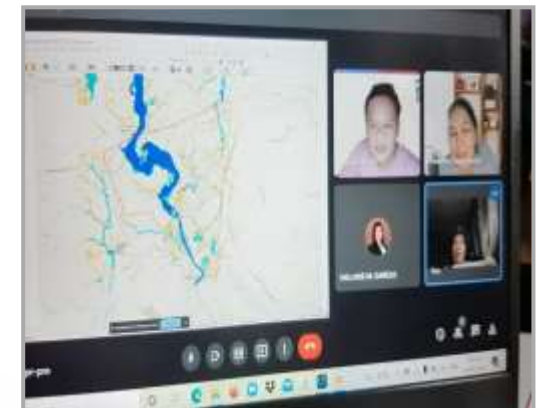
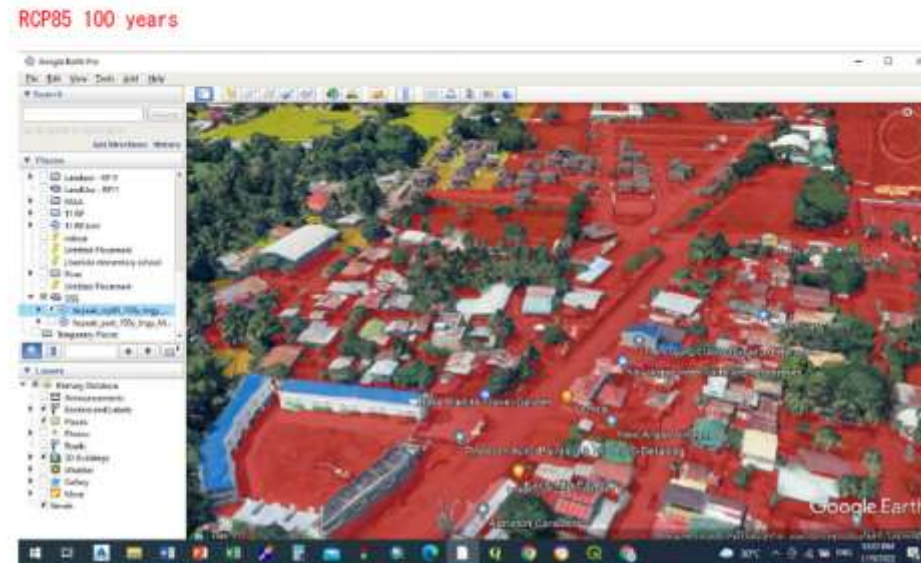
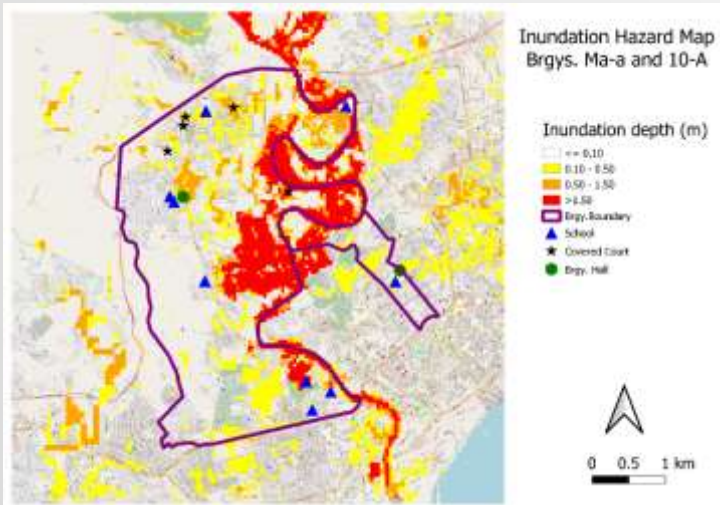


Inundation depth with their houses



Birds-eye view hazard map

## Future climate



Discussion among participants

# DAVAO OSS-SR: FEEDBACK & DISCUSSION

- Learn OSS-SR implemented in Japan and **benchmarking** on the best practices.
- Davao-OSS-SR Facilitators **grouping** according to expertise and strengths ( e.g. map experts, data analysts, communicators, influencers, etc) is suggested. The communicators may also be grouped according to the **target audience** or information users (e.g. community, DRRM team, policy makers, media, decision makers in the government or NGOs, private sector, academe, etc.).
- **Local information uploading** will be done by Facilitators who can act as data quality controller at present.
- **Data gaps** in the OSS-SR may also be filled out during the OSS-SR actual implementation. The outputs/deliverables of the OSS e-learning training workshop (1st and 2nd phases) may also be used as inputs or references during the **OSS actual implementation**.
- Is it possible also to present hazard maps thru **VR (virtual reality) and social media?** so the younger generation can be informed well about flooding.
- **Collaboration** with other domestic and international projects



# DAVAO OSS-SR: TARGET AUDIENCE FOR SCIENCE COMMUNICATION

Target Audience	Possible OSS Knowledge/Content to be disseminated/translated	Possible Communication Medium/Channel/Tool/Activity
<b>1. Local Communities</b> (youth group, women group, people's organization)	-Climate change & impacts -Why there is flooding -Contingency planning for DRRM	Poster Focus Group Discussion Radio / TV programs
<b>2. DRRM Team</b> (Barangay and City Level)	-Flood Hazard Mapping -Flood Monitoring -Risk Management (Prevention, Preparedness, Response, and Recovery)	Trainings Hand-outs
<b>3. Government Agencies</b> (DENR, DPWH, DILG, DOST, DSWD, DOH)	- Vertical and horizontal integration of DRRM plan and Development plan -Flood Hazard Mapping -Flood Monitoring	Focus Group Discussion Fact Sheet
<b>4. Policy Makers</b> (legislators and local government officials)	- Vertical and horizontal integration of DRRM plan and Development plan -Climate change & impacts -Why there is flooding -Contingency planning for DRRM	Policy Brief Fact Sheet
<b>5. Private Sector</b>	-Climate change & impacts -Why there is flooding	Fact Sheet Posters
<b>6. Media</b>	-Climate change & impacts -Why there is flooding	Media releases
<b>7. NGO and CSOs</b>	-Contingency planning for DRRM -Risk Management (Prevention, Preparedness, Response, and Recovery)	Focus Group Discussion Fact sheet

# PUBLICATION

*Water* 2022, 14(6), 978; <https://doi.org/10.3390/w14060978>

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## Co-Design for Enhancing Flood Resilience in Davao City, Philippines

by Mamoru Miyamoto<sup>1,\*</sup>, Daiki Kakinuma<sup>1</sup>, Tomoki Ushiyama<sup>1</sup>, Abdul Wahid Mohamed Rasmy<sup>1</sup>, Masaki Yasukawa<sup>2</sup>, Della Grace Bacaltos<sup>3</sup>, Anthony C. Sales<sup>4</sup>, Toshio Koike<sup>1</sup> and Masaru Kitsuregawa<sup>5</sup>

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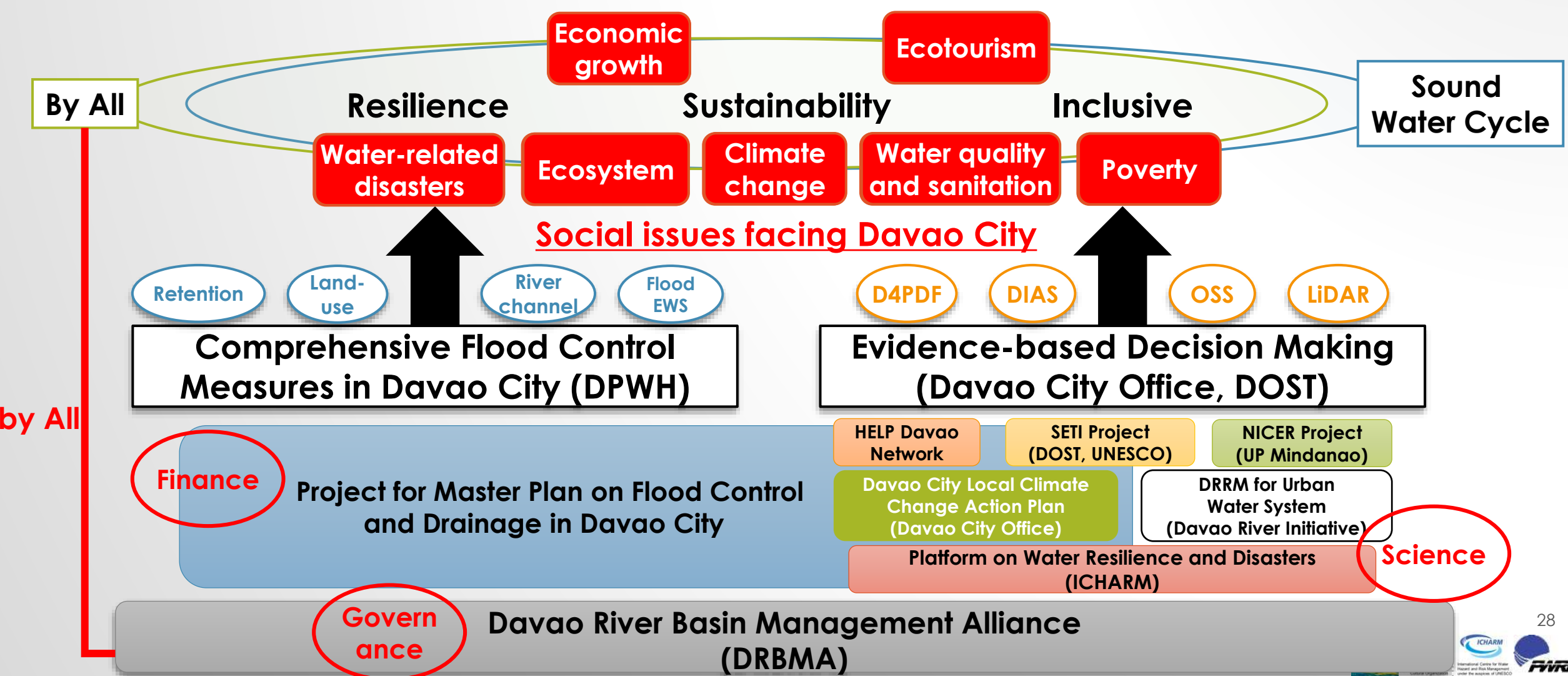
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# DAVAO OSS-SR: TOWARD SUSTAINABLE DEVELOPMENT

## Quality Growth





An aerial photograph of a densely populated city, likely in the Philippines, featuring a wide river that winds through the urban landscape. The city is characterized by a mix of colorful residential buildings and larger commercial structures. In the background, a large mountain range is visible under a clear blue sky. The overall scene is bright and clear, suggesting a sunny day.

**THANK YOU SO MUCH  
FOR YOUR KIND ATTENTIONS!**

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