

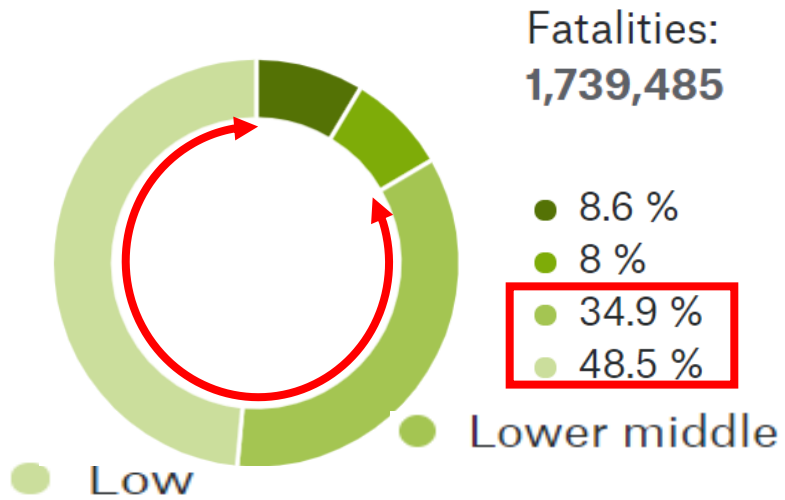
Side event
Water-Energy-Food Nexus for Sustainable Development

Improvement of resilience to floods and droughts under climate change and building a sustainable society

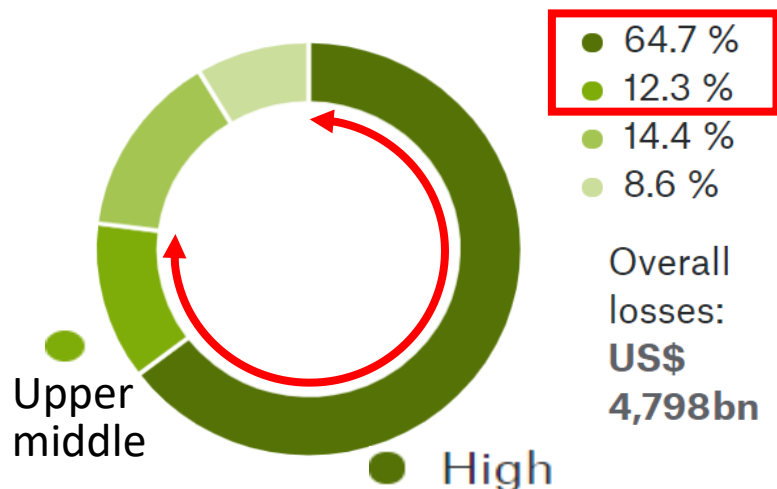
KOIKE, Toshio
Executive director, International Centre for Water Hazards and Risk Management
(ICHARM) , Public Works Research Institute (PWRI)
Professor Emeritus, the University of Tokyo



Overall Human Loss Events Worldwide 1980-2018



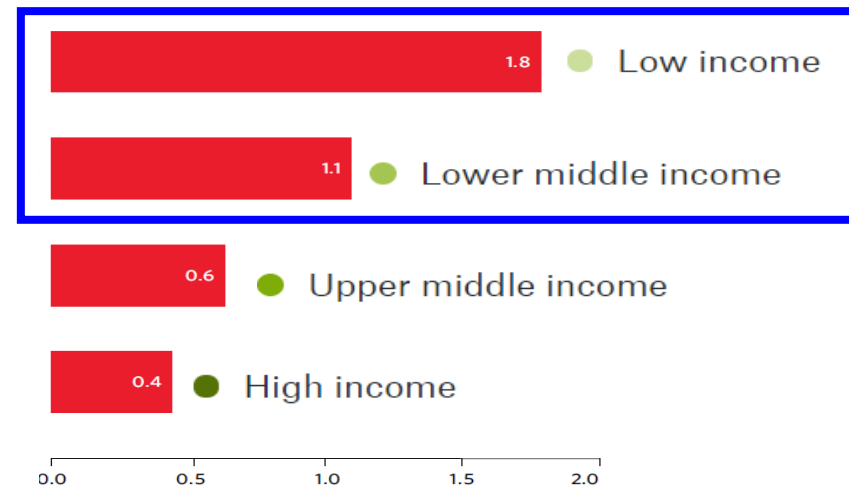
Overall Economic Loss Events Worldwide 1980-2018



The 2030 Agenda

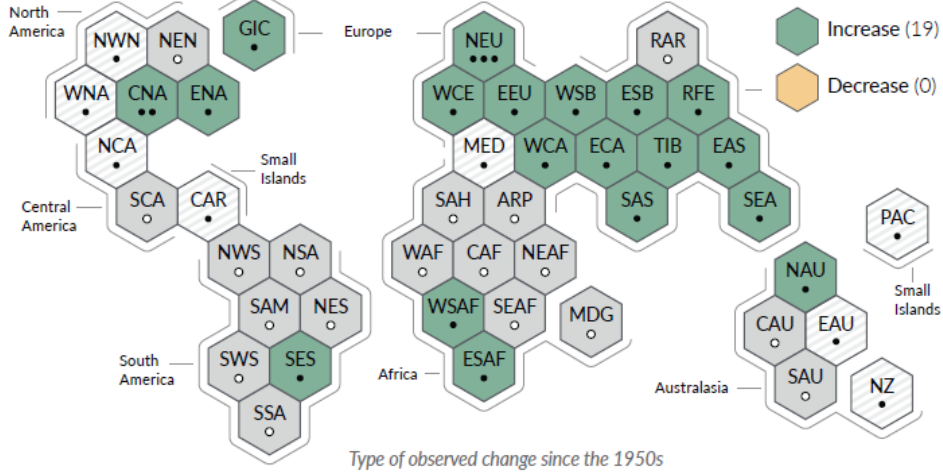
We are determined to take the bold and **transformative steps** which are urgently needed to shift the world onto **a sustainable and resilient path**. As we embark on this collective journey, we pledge that **no one will be left behind**.

Economic losses (relative to GDP) caused by climate-related disasters, 1998-2017 (%)

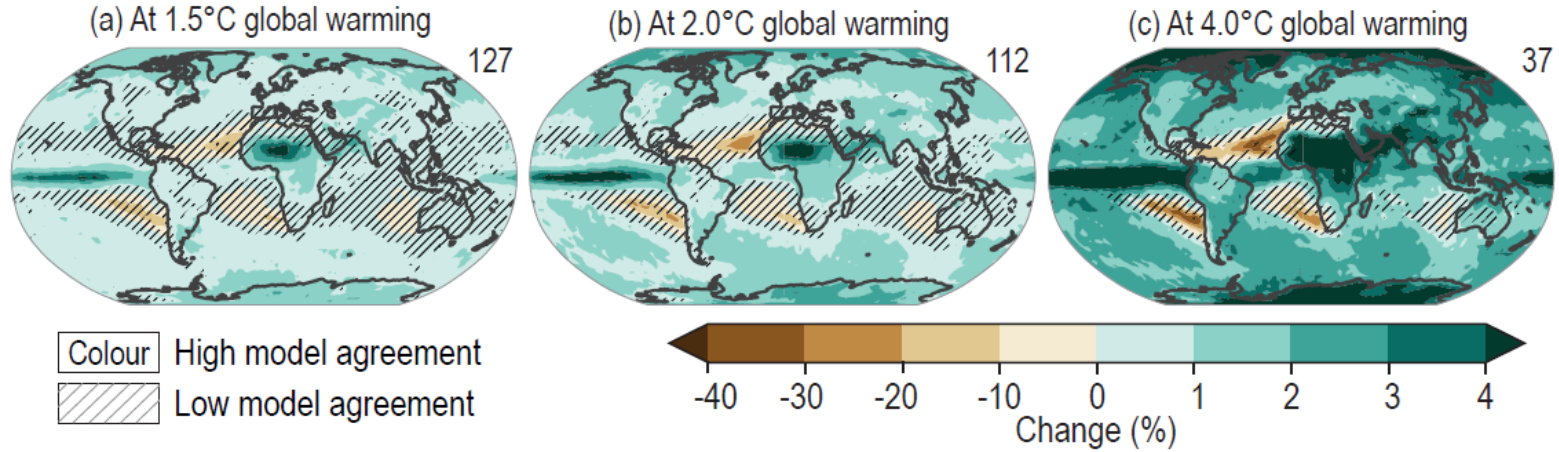


IPCC/AR6/WG1, 2021

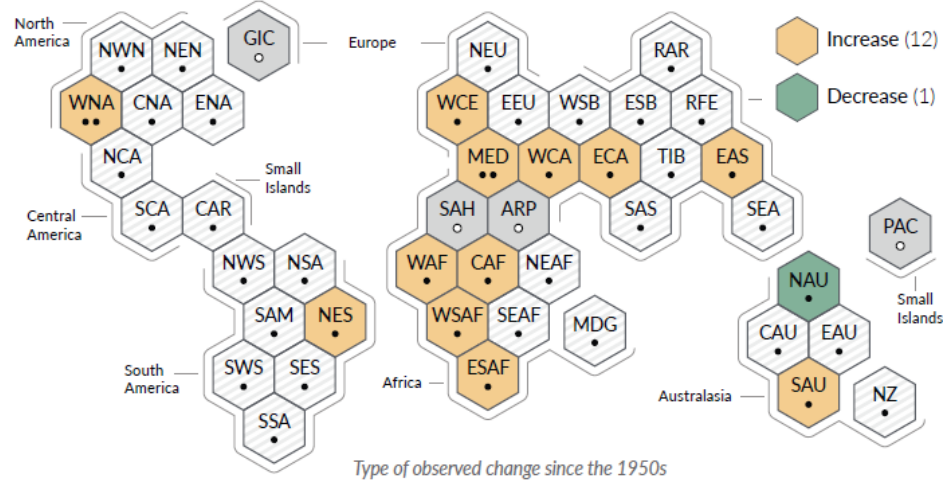
Observed change in heavy precipitation in the world's regions.



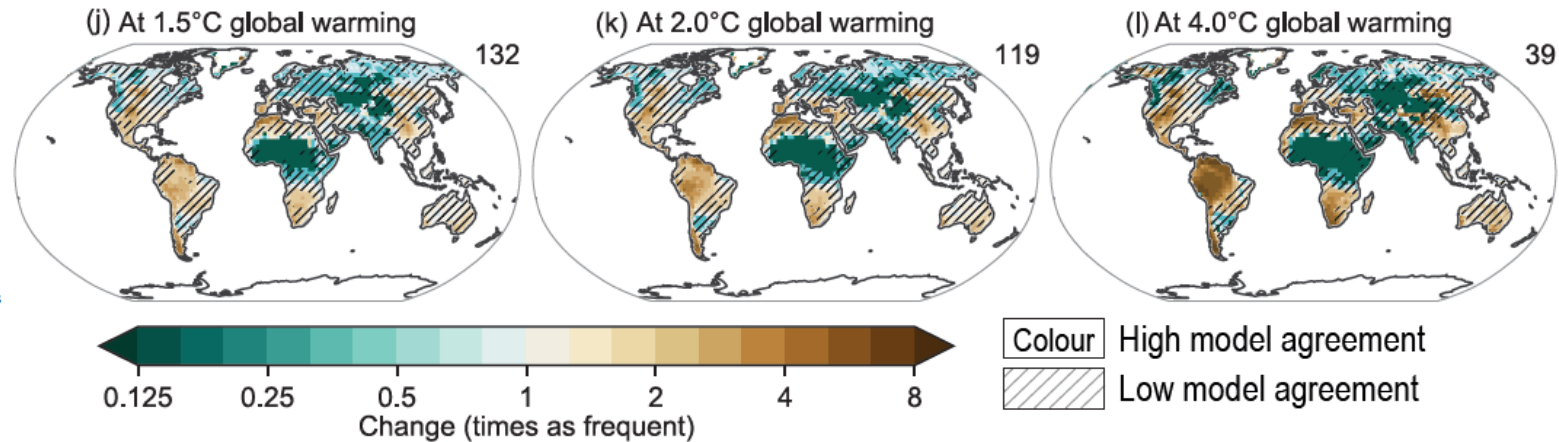
Projected changes in annual maximum daily precipitation at each global warming compared to the 1850-1900 baseline.



Observed change in agricultural and ecological drought in the world's regions.



Frequency of 1-in-10-year soil moisture drought at each global warming compared to the 1850-1900 baseline.



Transformative Step towards a Sustainable and Resilient Path

Coordinated and Integrated Efforts for Working Together

mitigation

Climate Change

adaptation

Regime Shift

Extremes

Space/Time

Floods/Droughts

Climate System

Water Cycle

Food

Energy

Ecosystem

Urban

QoL

Poverty

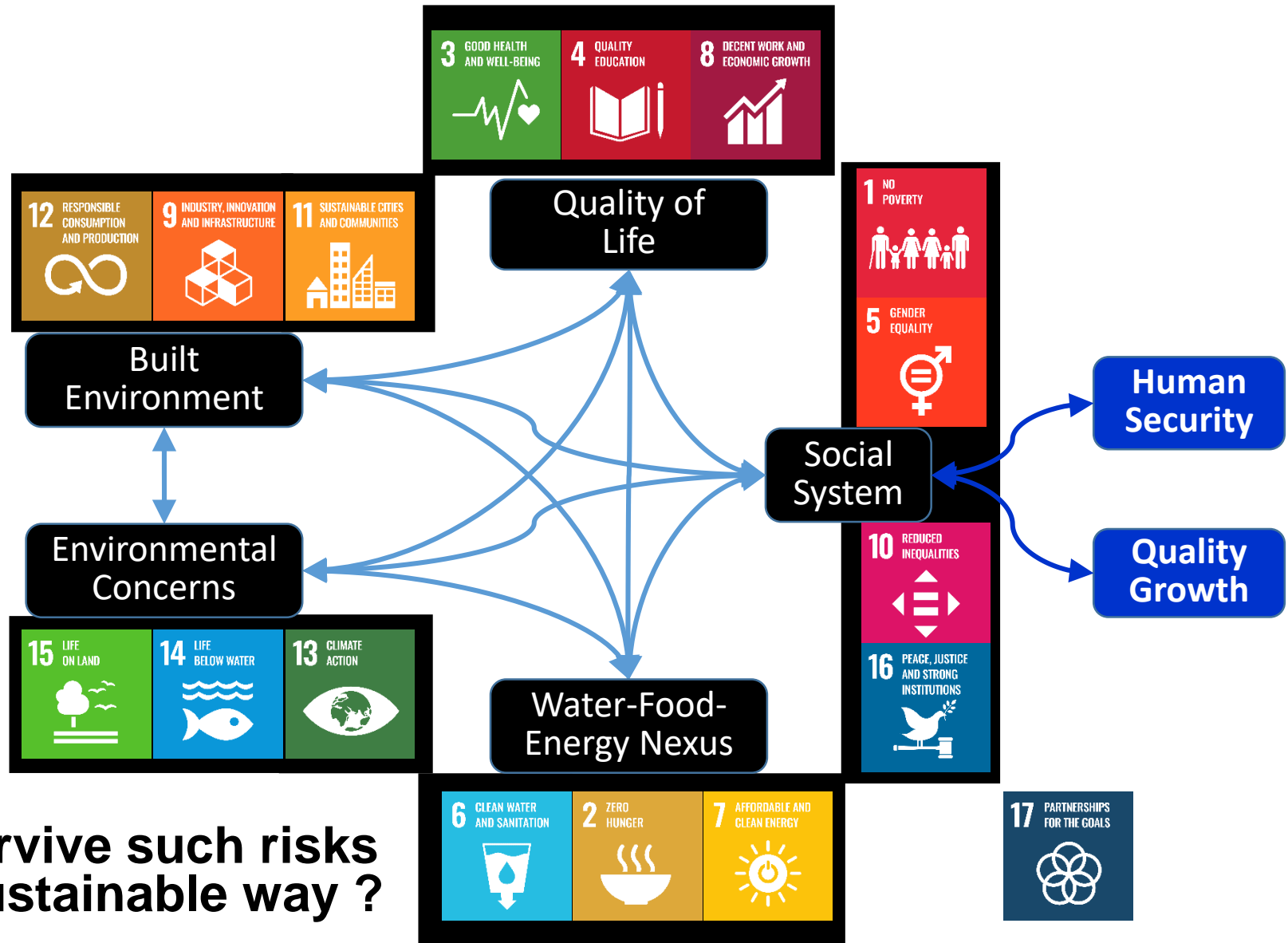
Water Resources Management System



How should humanity survive such risks and live with them in a sustainable way ?

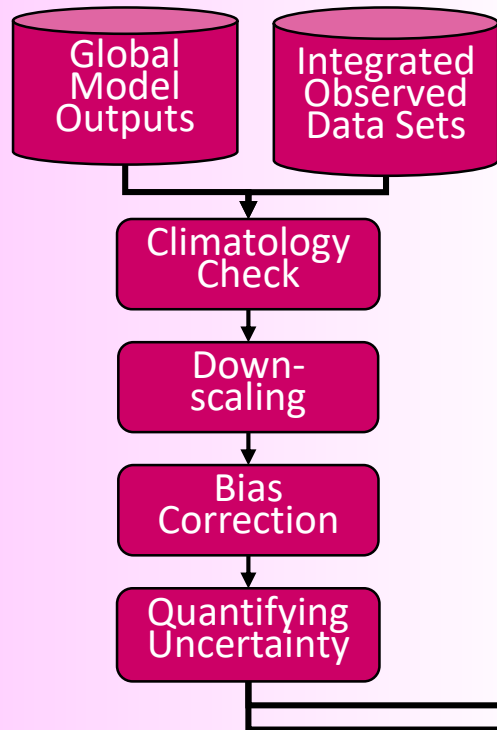


Cross-sectral Decison Making

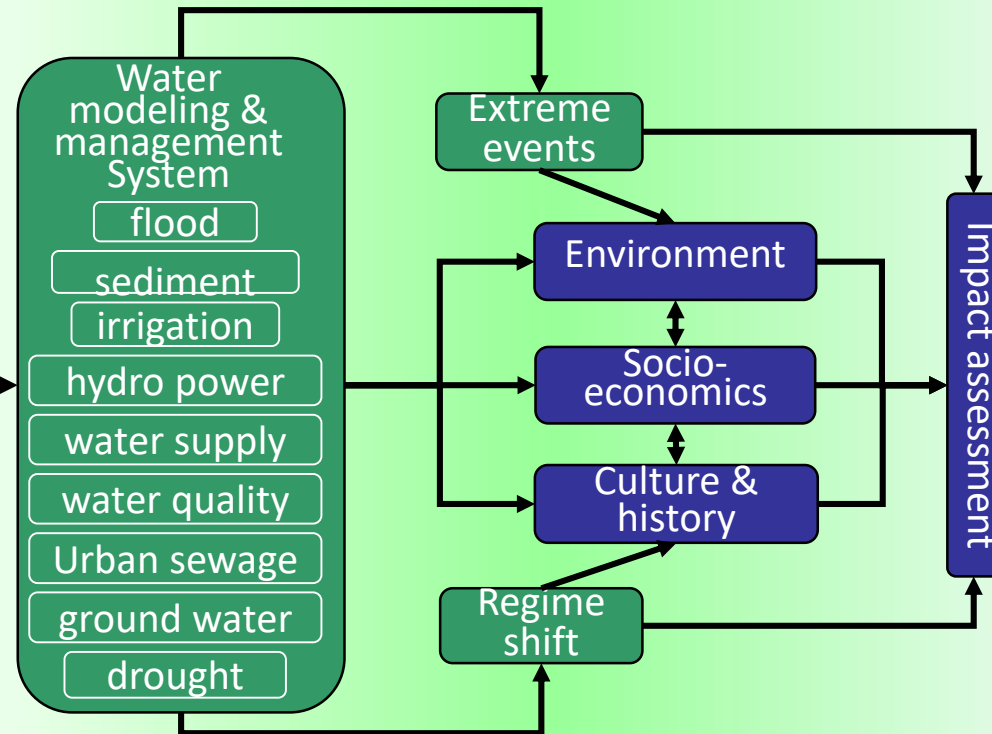


How should humanity survive such risks and live with them in a sustainable way ?

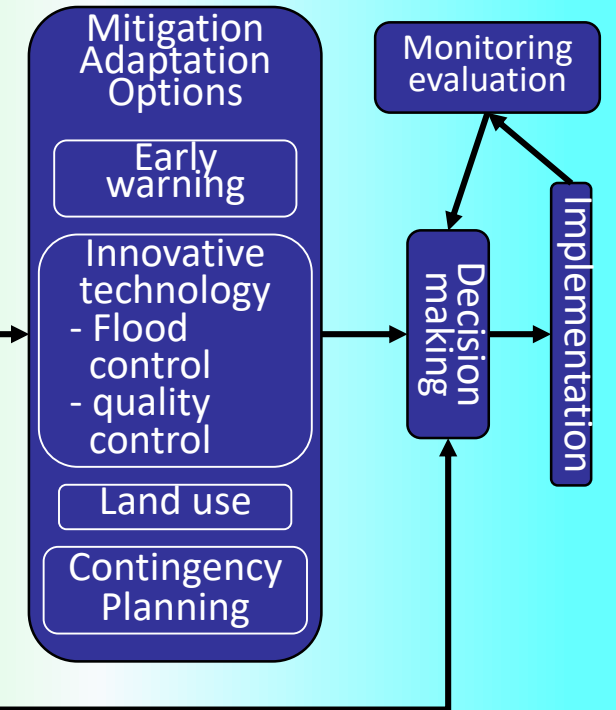
Meteorological observation, modeling and prediction



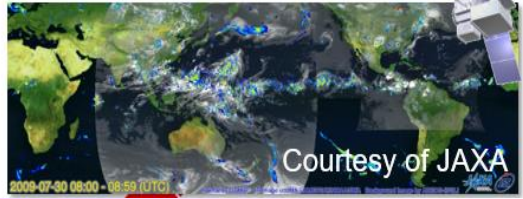
Hydrological observation, modeling and prediction



Cross-sectoral decision-making support

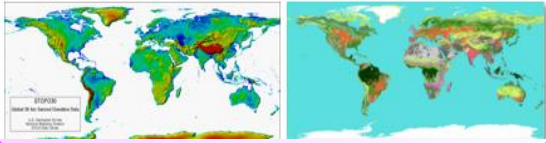


Ground-gauged and satellite rainfall

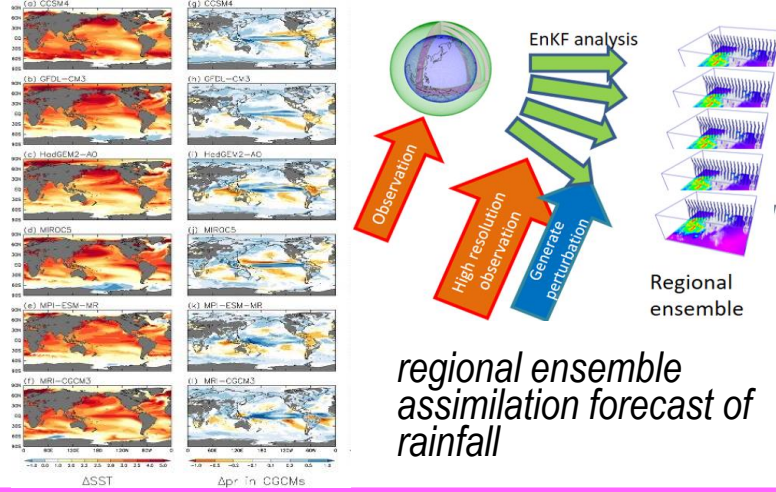


Courtesy of JAXA

Global data: topography, land use, etc.

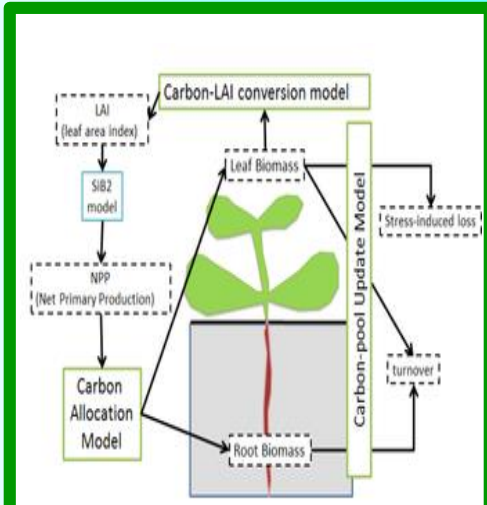
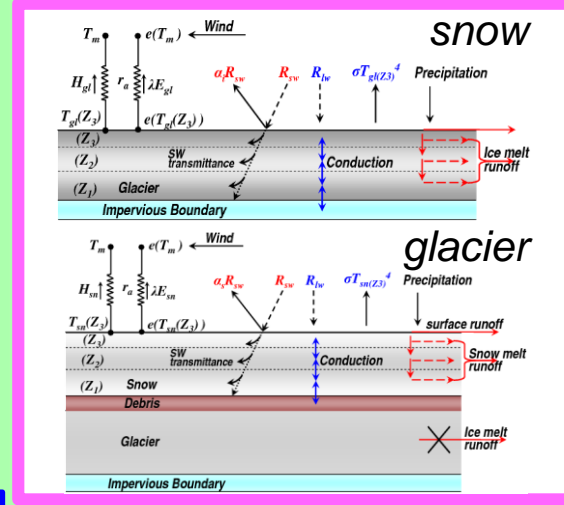


Quantifying uncertainty of climate change: Down-scaling of large ensemble projections



regional ensemble assimilation forecast of rainfall

Water-Food-Energy Nexus Monitoring and Prediction



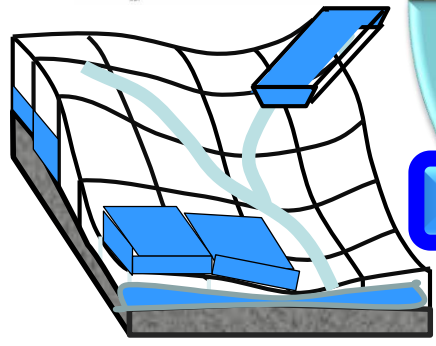
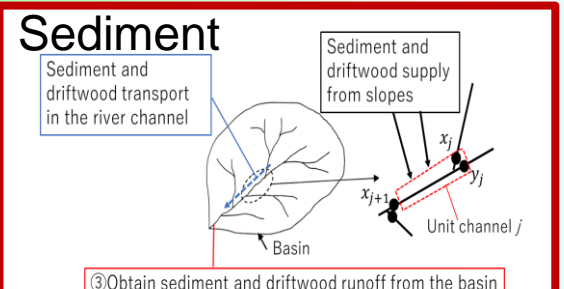
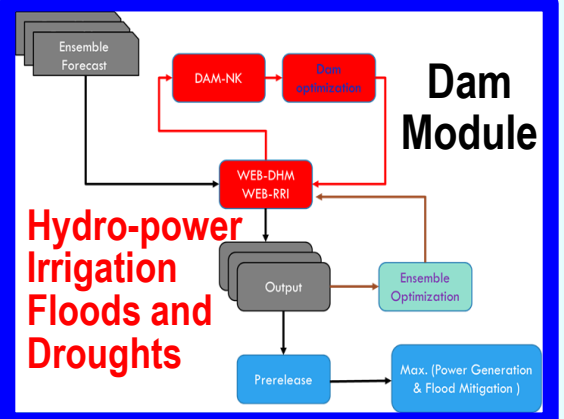
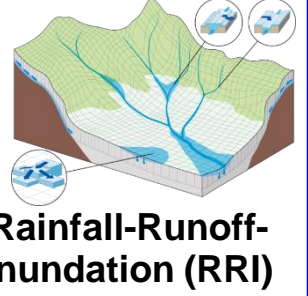
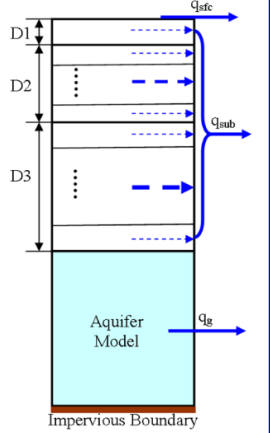
Energy and Water Flux Balance

Vertical Soil Moisture Profile

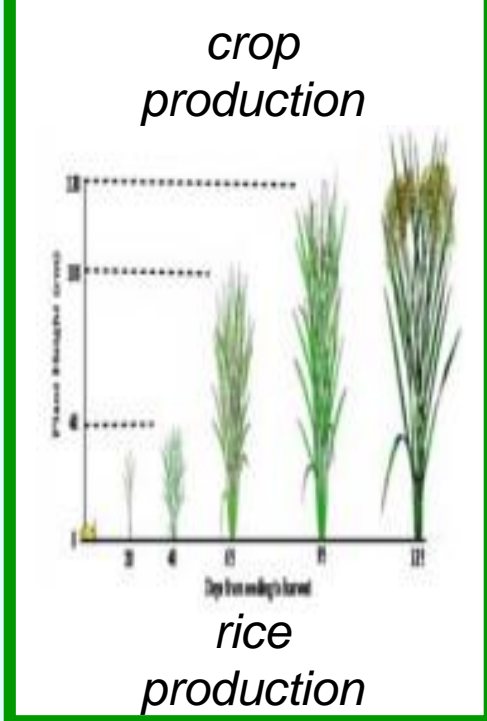
Water & Energy Budget RRI (WEB-RRI)

River Flow

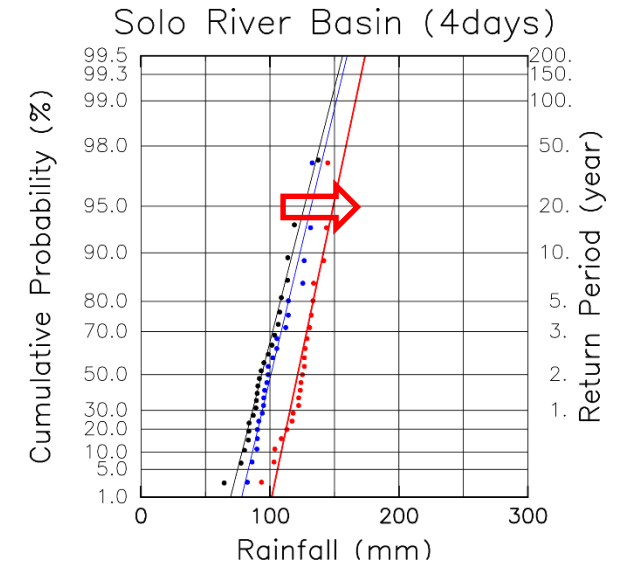
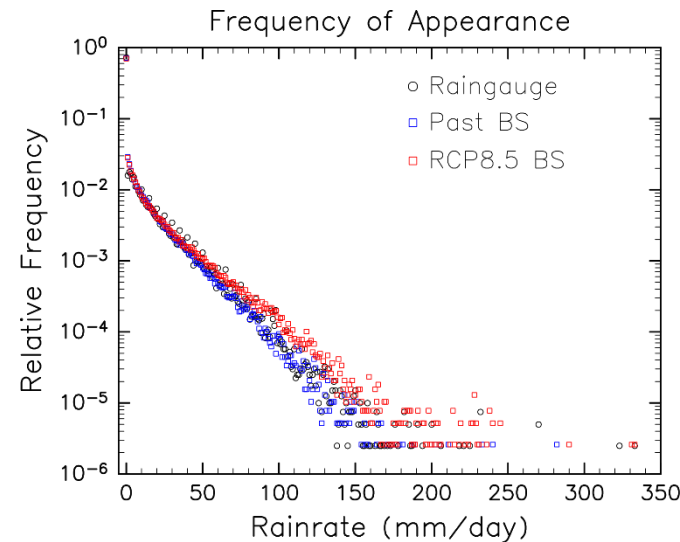
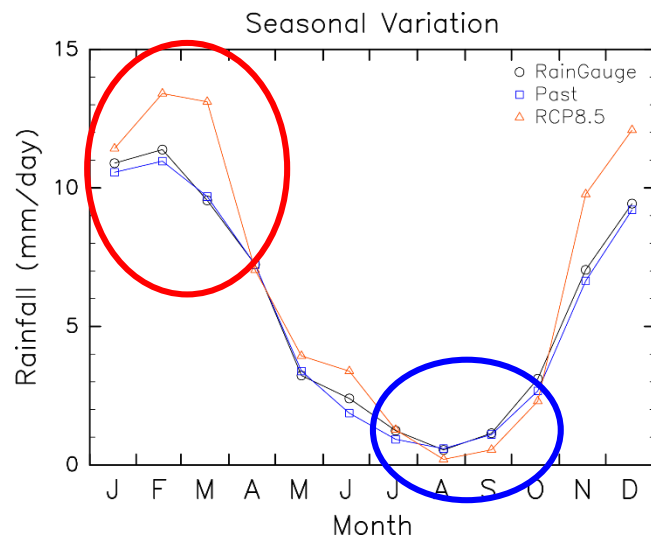
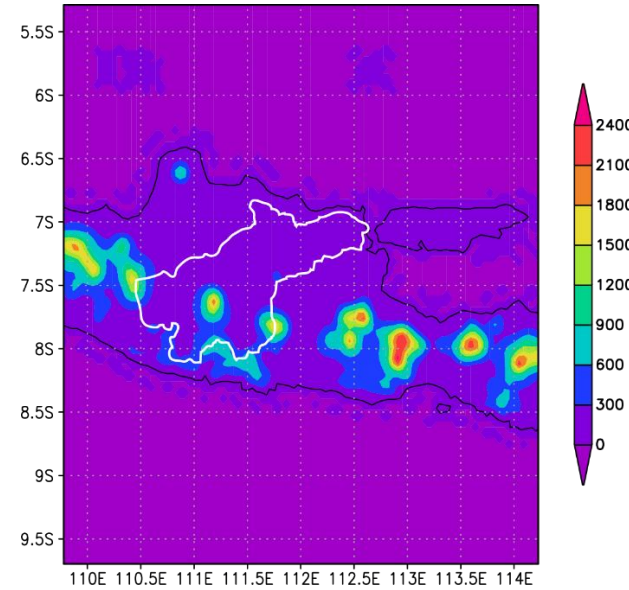
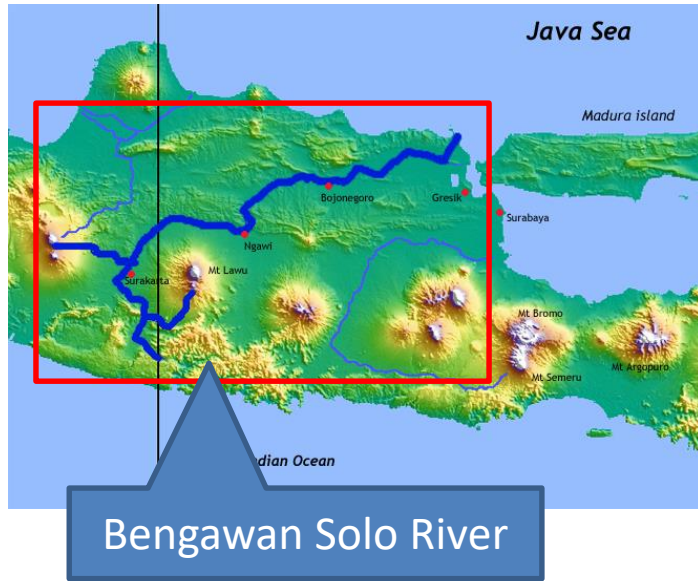
Surface Ground Water



Seamless Simulation for Drought-Normal-Flood

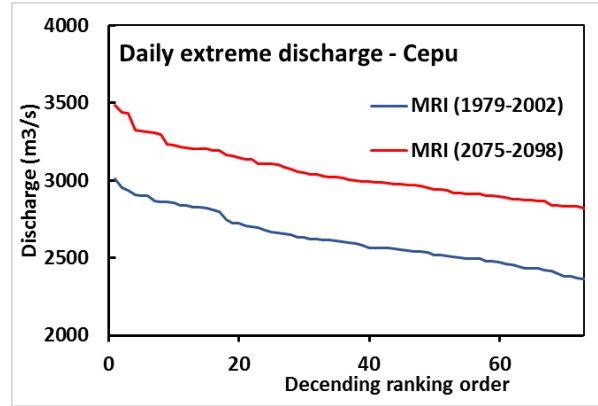


③Obtain sediment and driftwood runoff from the basin



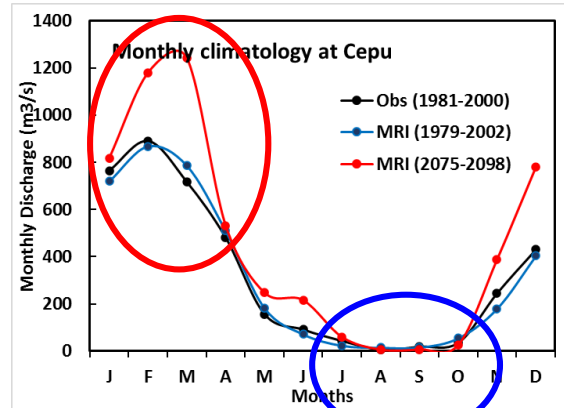
River Discharge (m³/s)

Daily rank-order



→ Extreme flow conditions increase future

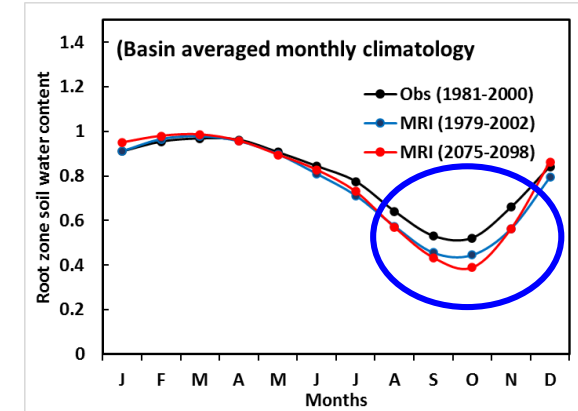
monthly mean



→ Flow in Sep. and Oct decreases
→ In other months increase

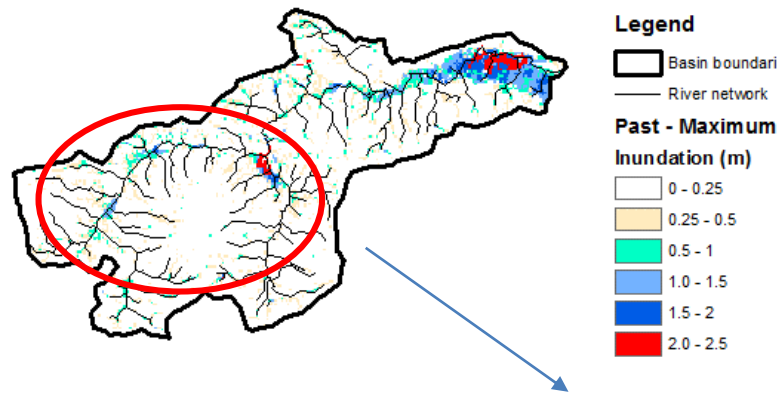
Root zone soil water content

monthly mean

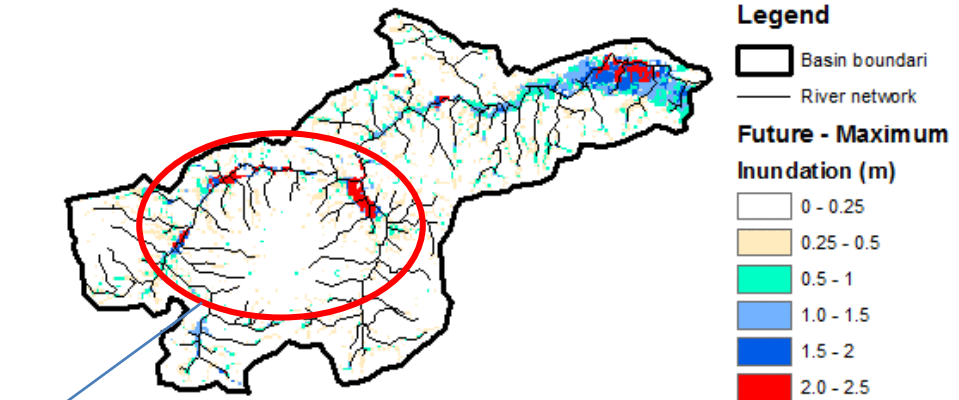


→ Sep. and Oct. decrease
→ Dec. Jan. and Feb. increase

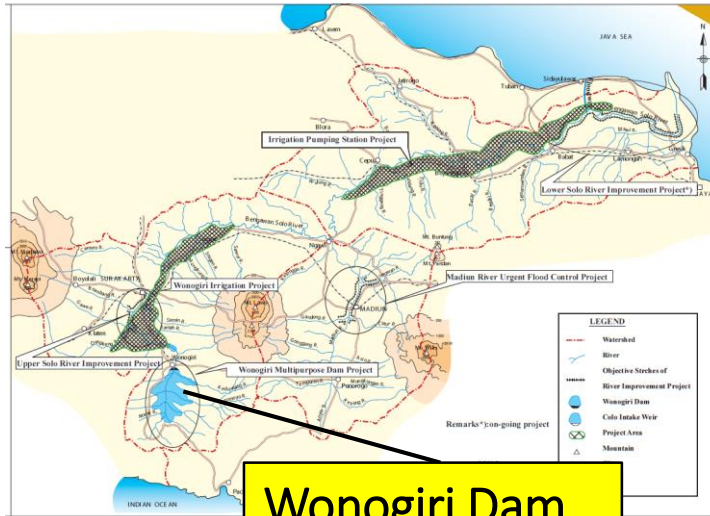
(a) MRI – PAST Maximum Inundation



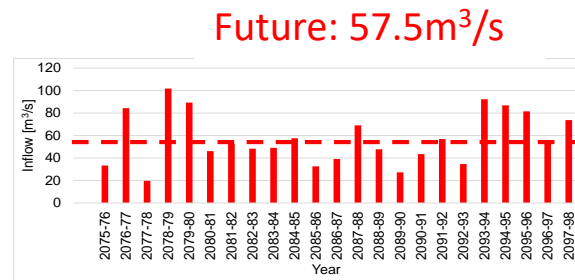
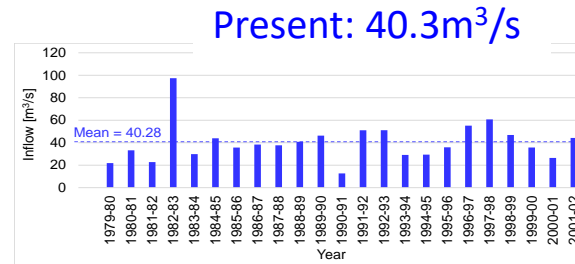
(b) MRI – FUTURE Maximum Inundation



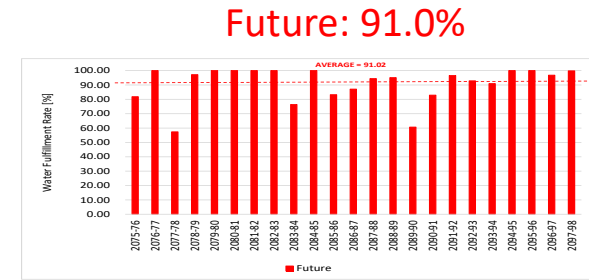
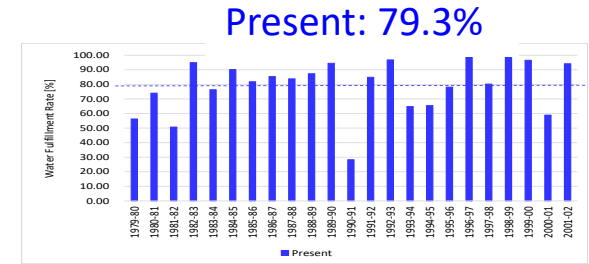
More area will be inundated in the future climate



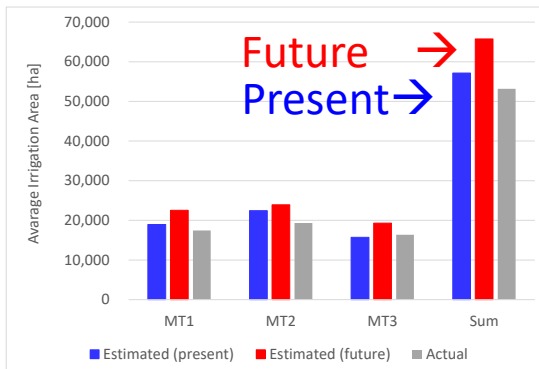
Wonogiri Dam
C.A.=1,350km²



Yearly averaged inflow



Average Water Fulfillment Rate

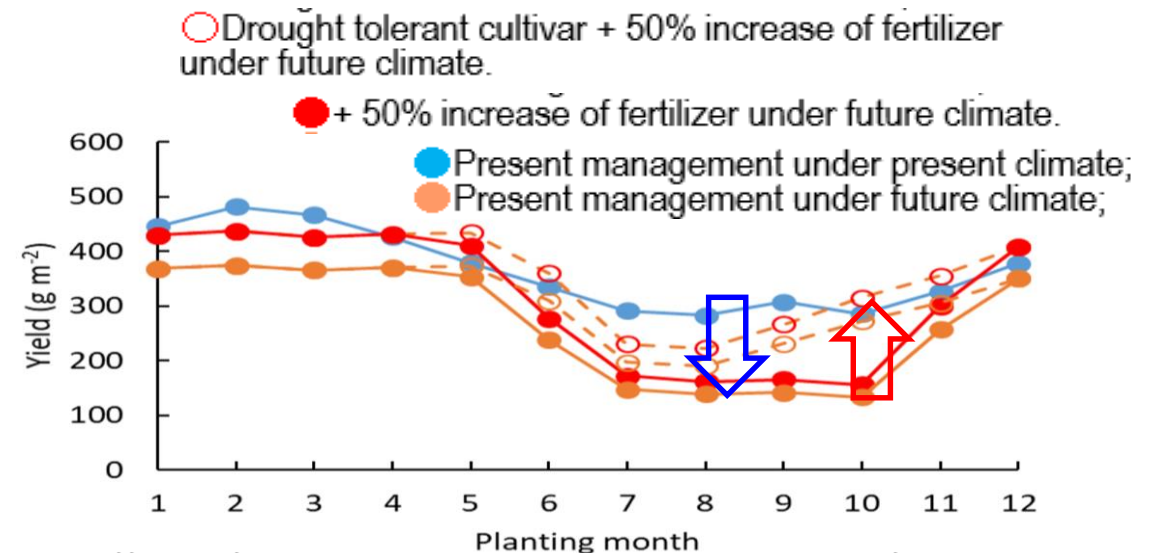


MT1: Nov.- Feb.
MT2: Mar.- Jun.
MT3: Jul. – Oct.

Estimated Irrigation Area

Input-Output Analysis

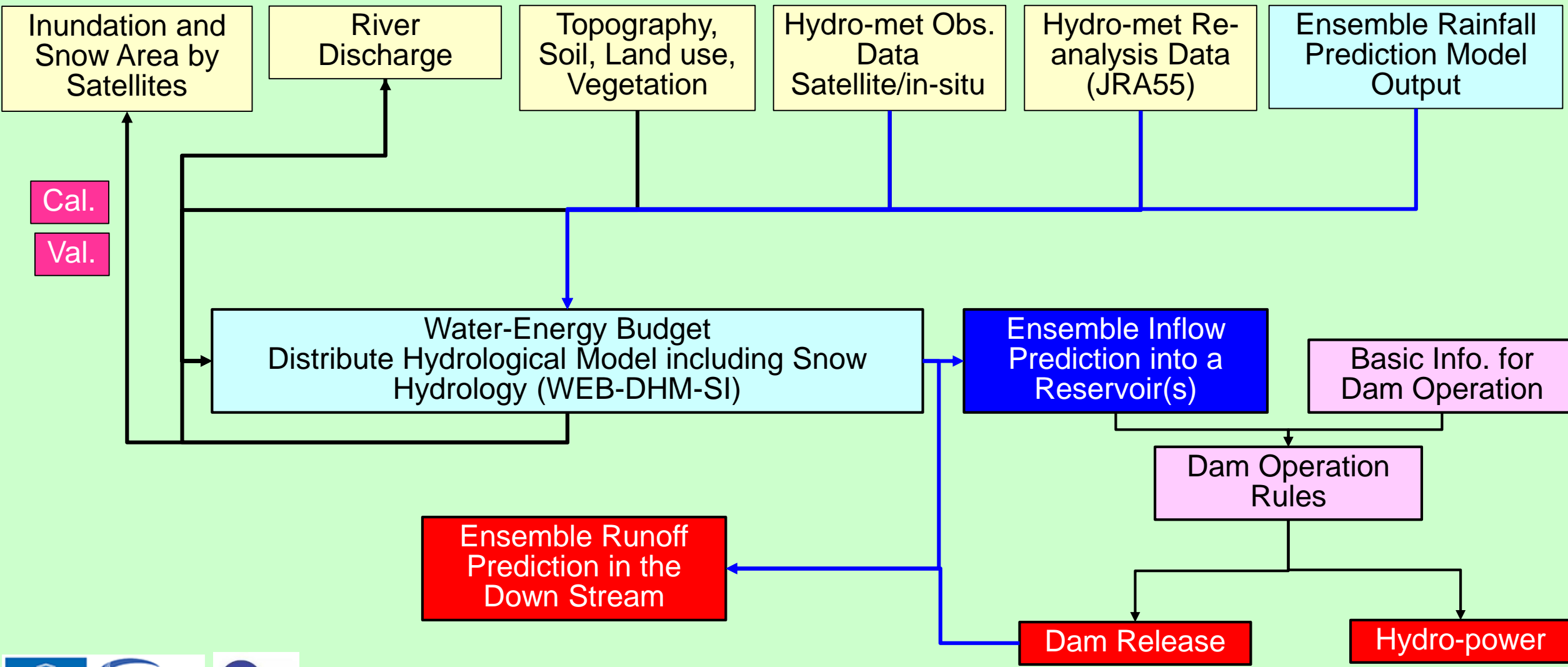
- Direct effect of increasing paddy rice production: **237 billion rupiah**
- Induced production of other industries: **59.5 billion rupiah**
- Total economic effect: **296.5 billion rupiah (2015 price)**



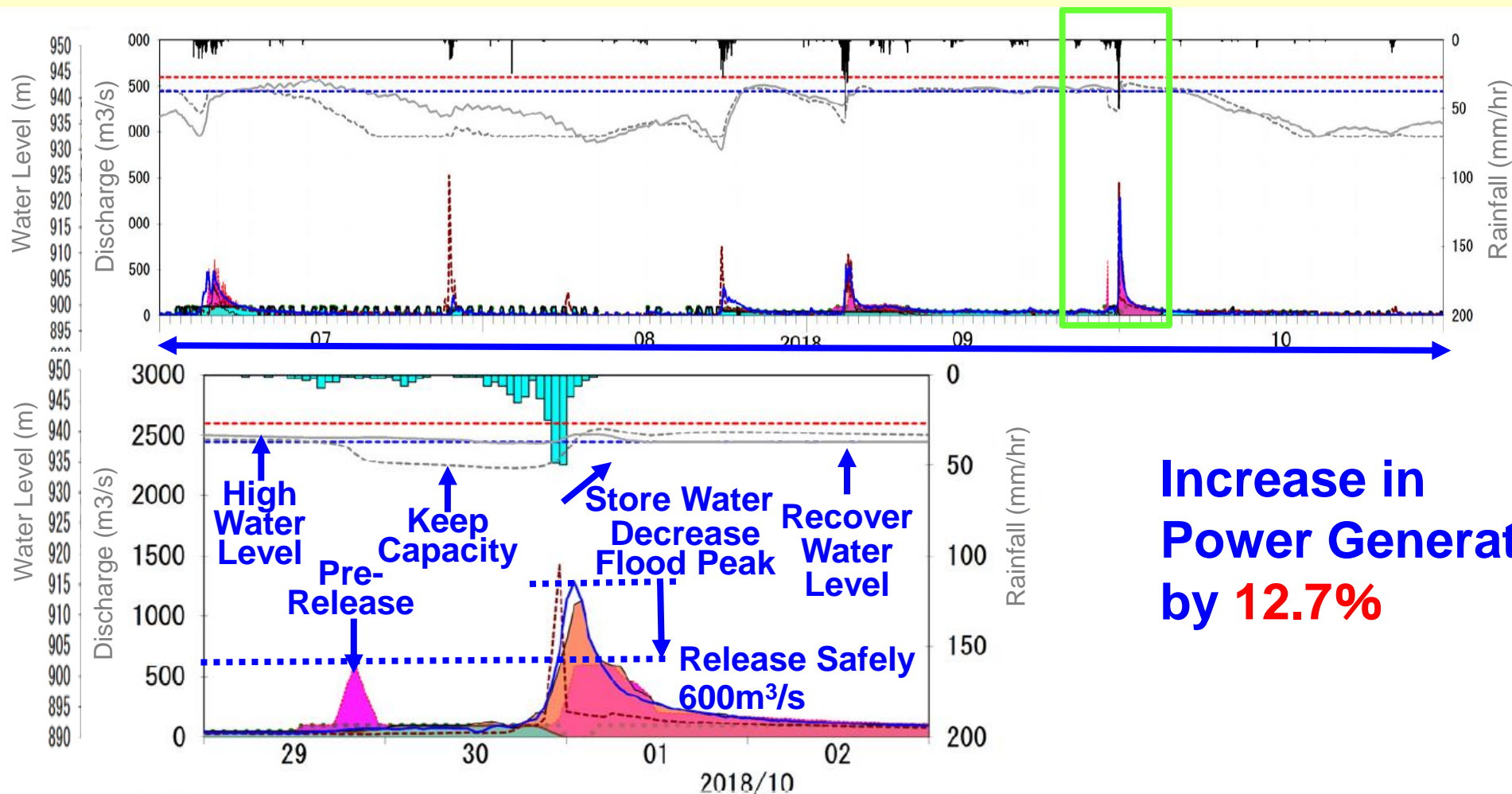
Effect of planting month on rice yield (Rainfed ecotype)

Runoff Simulation

Rainfall Prediction



Water-Energy: Dam Operation Supports



Increase in Power Generation by 12.7%

- Observed
- █ rainfall
- █ inflow
- reservoir water level
- █ gate discharge
- █ discharge for power generation

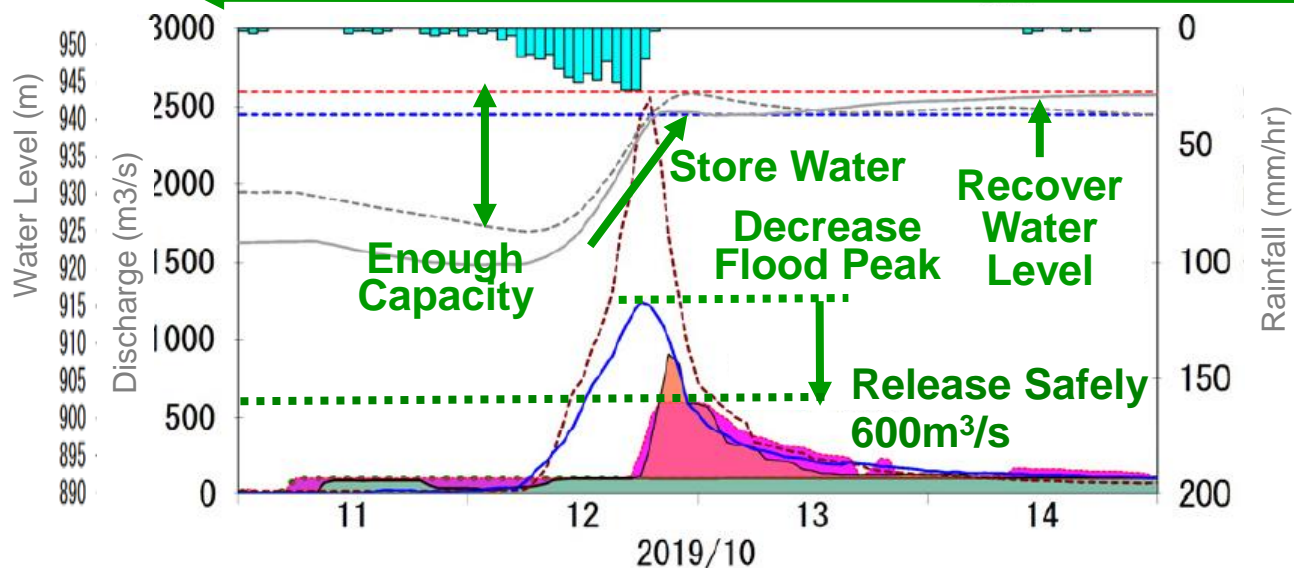
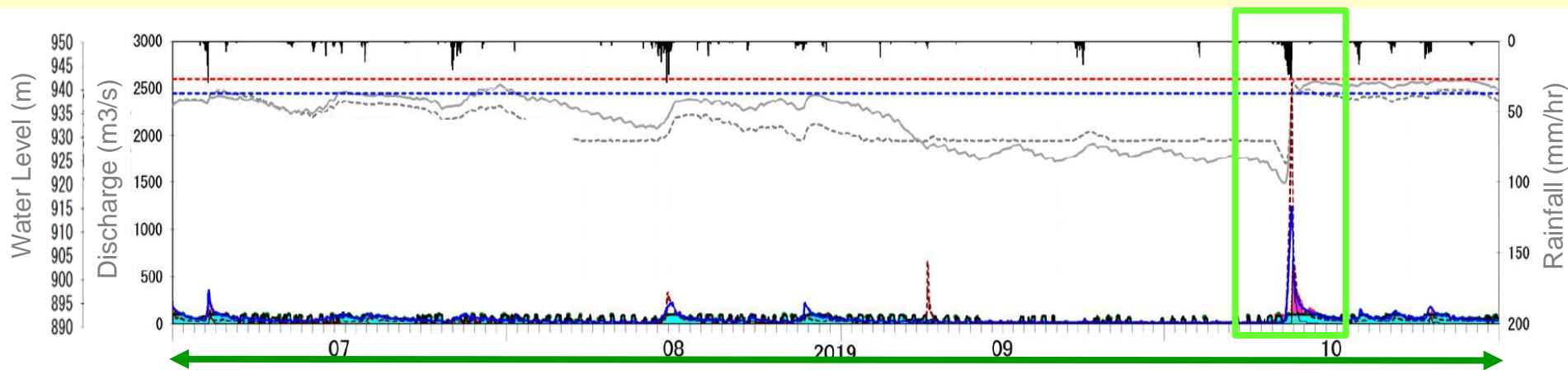
- Outputs from the support system
- - - forecasted inflow
- - - - reservoir water level
- █ gate discharge
- █ additional discharge for power generation

- - - Full reservoir level
- - - - Safe water use level

Koike et al, 2021



Water-Energy: Dam Operation Supports



Increase in Power Generation by 3.7%

- Observed**
- █ rainfall
 - █ inflow
 - █ reservoir water level
 - █ gate discharge
 - █ discharge for power generation

- Outputs from the support system**
- - - forecasted inflow
 - - - - reservoir water level
 - █ gate discharge
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- - - Full reservoir level
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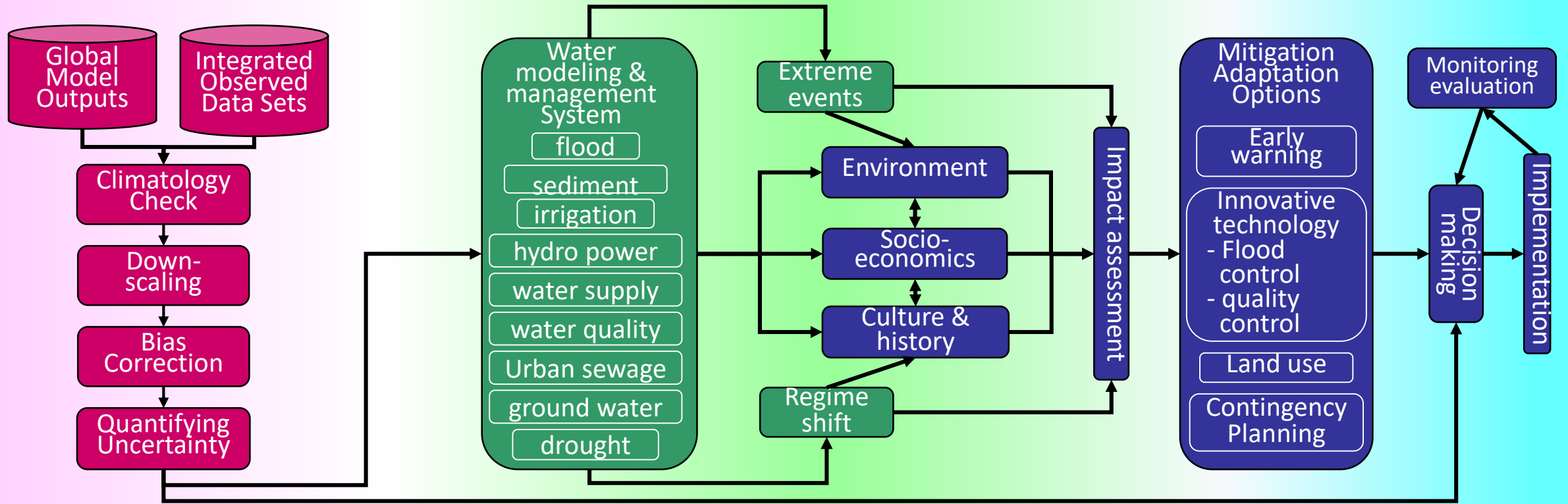
Koike et al, 2021



Meteorological observation, modeling and prediction

Hydrological observation, modeling and prediction

Cross-sectoral decision-making support



Promoting Knowledge Integration
Capacity Building and Education



Society/ Stakeholders

Bridging Gap

- User Needs
- Local Data
- Indigenous Knowledge

- trust-based relationship
- causes and structure of on-site problem, and local implications of data and information
- goals, possible solutions, and governance
- stakeholders' responsibilities
- convincing

Facilitator
not just as "a master of ceremony"
but as "catalytic beings"

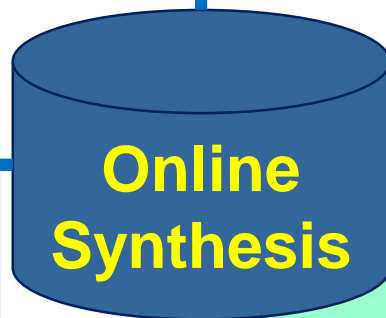
Science Community

Fresh Learning

Maximum Use

Knowledge Integration

New Frameworks



- Socio-economic survey data and statistics with large variety and strict confidentiality.
- Observation, monitoring and prediction data with large volume & high throughput.

Functions

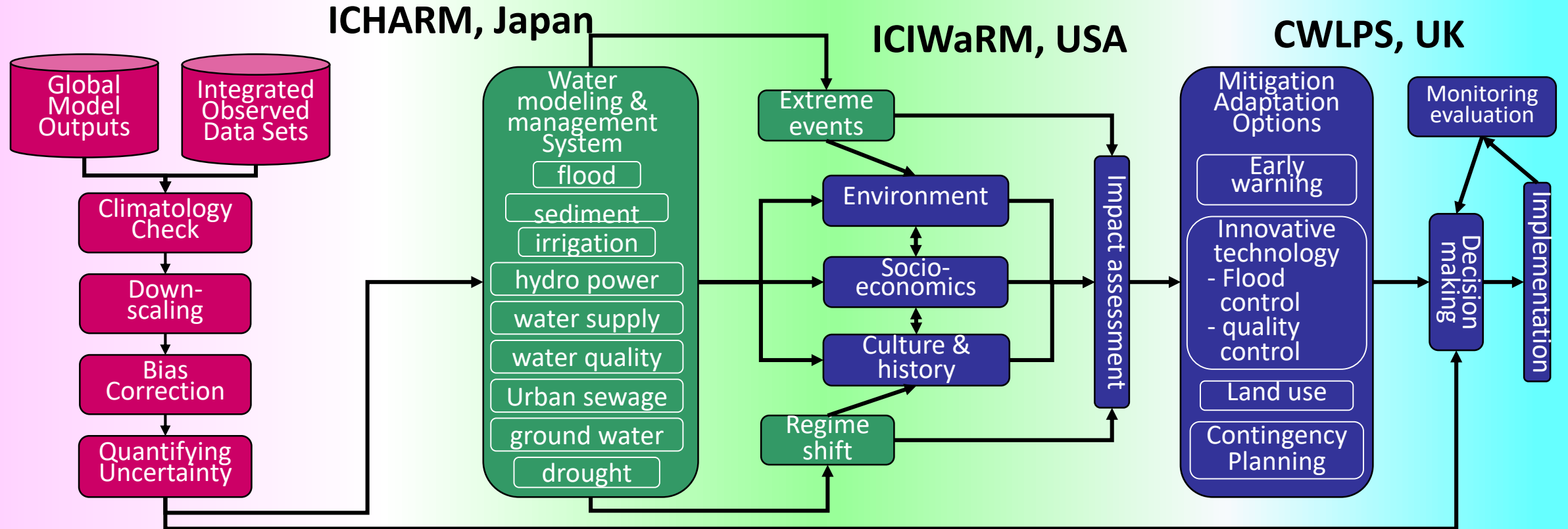
- Exploration, collection, archive and search of scientific information in mother tongues
- Prediction and simulation, and visualization
- Data integration, information fusion
- Coordination of various disciplines
- Mutual risk communication between society and science community

Working in Partnership with Africa

**Meteorological observation,
modeling and prediction**

**Hydrological observation,
modeling and prediction**

**Cross-sectoral
decision-making support**



ICWRGC, Germany

Promoting Knowledge Integration : **Online Synthesis**

IHE Delft, Netherland

Capacity Building and Education : **Facilitator**



United Nations

UN 2023 Water Conference
22 – 24 Mar 2023, New York

Interactive Dialogue

Water for Climate, Resilience and Environment

The key for breakthrough is, among other things, the Open Science Policy, facilitation between science and decision making, end-to-end approach, and water cycle integration.



Co-chairs
Mr. Sewilam and Ms. Kamikawa

Transformative Step towards a Sustainable and Resilient Path

Coordinated and Integrated Efforts for Working Together

mitigation

Climate Change

adaptation

Regime Shift

Extremes

Space/Time

Floods/Droughts

Climate System

Water Cycle

Food

Energy

Ecosystem

Urban

QoL

Poverty

Water Resources Management System

Water-Food-Energy Nexus Monitoring and Prediction

Online Synthesis Facilitation

Side event
Water-Energy-Food Nexus for Sustainable Development

Improvement of resilience to floods and droughts
under climate change and building a sustainable society

Thank you for your attention.



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BUDAPEST